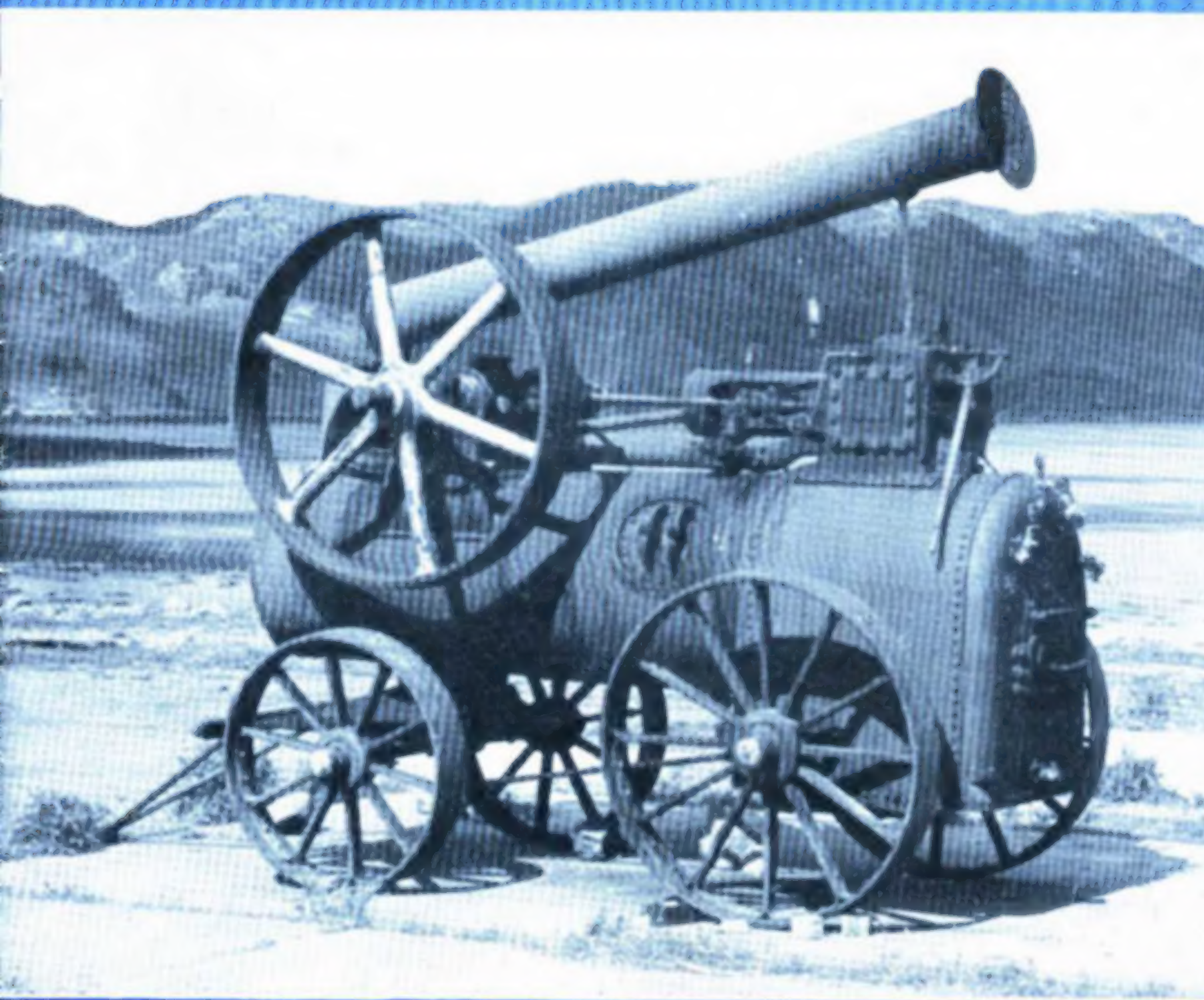
THE MODEL ENGINEER



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THE MODEL ENGINEER

EVERY THURSDAY

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Our Cover Picture

We are indebted to Mr. Bostock Stanley, of Kenton, for the photograph reproduced on our cover this week. This engine was discovered by chance, and another photograph of it, together with a letter by Mr. Stanley, appears elsewhere in this issue. We know that many of our readers are keenly interested in the portable engine, and some are experts in their history; therefore, we are hoping that somebody may be able to let us have some information concerning this one. The photographs show that precautions have been taken to ensure that the engine will not move under the persuasive influence of, say, a high wind! It is plain that the engine is complete and in fairly good condition; so the illustrations may be useful to anyone engaged in building a model. The marked coning of the wheels is clearly seen.

SMOKE RINGS

Her new Home

A NICE little Aveling traction engine, built in 1871, was found not long ago in a deplorable condition in a yard near Maidstone. Enterprising members of the Road Locomotive Society, however, took steps to have her restored to first-class trim and have presented her to the Science Museum, South Kensington, where she will eventually be on view. She is a pretty little engine, except for her rather gaunt-looking chimney, which is of plain stovepipe pattern. She is the first full-size traction engine to find a home in the Science Museum, and because of that, there must be hundreds of our readers who will find a new interest there, in due course. At present, we know nothing of her history, but presume that she has, until now, spent the whole of her working life in Kent, the county of her birth. We wonder how many people seeing her for the first time, in the museum, will guess that she is now getting on for 73 years of age! To have her preservation ensured is a matter for universal satisfaction.

A Wasted Workshop

IN A letter from Mr. F. W. Dunham, hon. secretary of the Hatfield and District S.M.E., he makes the following rather mournful comment:—

"Doubtless, many other clubs have survived the same difficulties, but it is ironical to reflect that when this society was formed, shortly after the war, it had 30 members all eagerly planning what could be done if we had a club workshop; now that, after years of searching and dwindling enthusiasm, we have succeeded in finding ideal accommodation, we find that the few members remaining are those who already have workshops of their own, and so have little need of the club equipment."

This is not the only case of its kind that has come to our notice, though not just lately; the reason for the state of affairs described by Mr. Dunham is, of course, difficult for us to discover without probing much more closely into local circumstances. We take it that every effort has been made to ensure that all past members know of the society's good fortune in finding ideal accommodation for its workshop equipment. There is, of course, the possibility that, in spite of all efforts, the good news failed to reach everybody concerned. If this is so, we think that, in such cases as this, the "M.E." can be of some assistance, simply because it is more than likely to reach every *model engineer* in the locality. We suggest that the *frequent* publication, in our pages, of club announcements and general news, even if it amounts to only a couple of lines per insertion, would greatly help. For our part, we are glad to give this service, which is free to all clubs. We know that it works; but *frequent* is the operative word.

A Dutch Exhibition

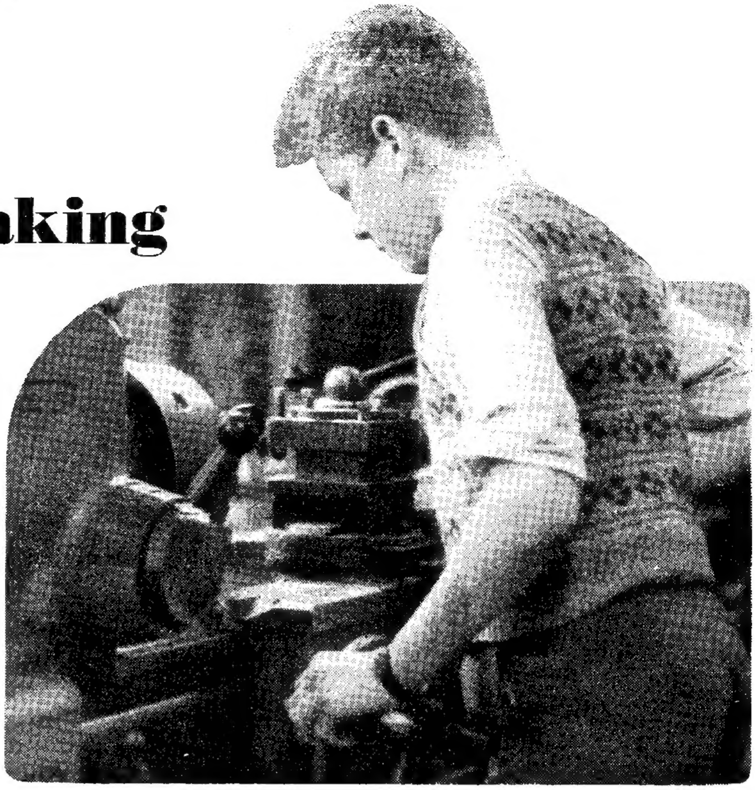
WE HAVE been advised that from May 25th to June 7th, 1954, there is to be held in Rotterdam, an exhibition to be known as "De Gouden Schakel" (The Golden Link) Exhibition, in connection with an International Hobby Festival. The exhibits will be classed under such groups as: Oldtime cars; a dream-building; a tankship; a railroad with full details; a half scale free-flight control-line aircraft model of the S.A.A.B. "Safir," and a non-flying model of the Sikorsky S-55 helicopter. There is also a competition being prepared for building a sailing ship and a Diesel locomotive. The organisers are willing to take any representative British exhibits.

Further details may be obtained from: Secretariat van de Stichting, "De Gouden Schakel," Johan van Oldenbarneveldtlaan 30, Den Haag (The Hague), Holland. Letters should be marked "For the attention of Mr. L. v. Dyck."

Engineers in the making

TRAINING BOYS AT THE WOOLWICH POLYTECHNIC

By Antony Glasier

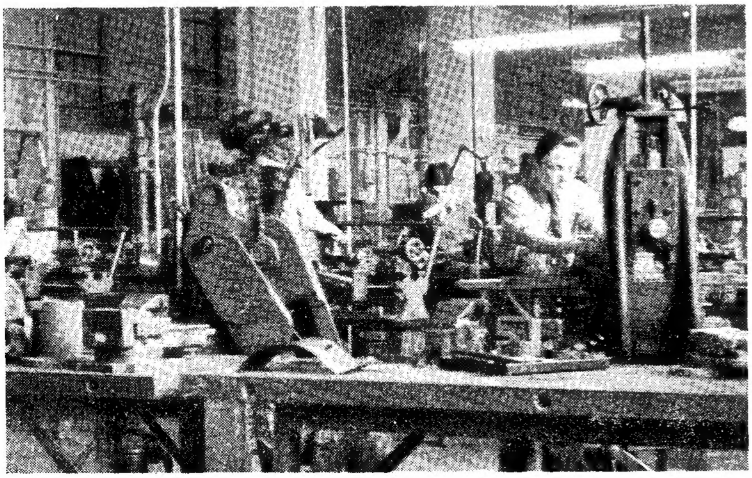


Most pupils take a strong interest in machining operations

WOOLWICH is the second largest Metropolitan borough, and is the only one to be situated both north and south of the Thames. It is a centre of almost every branch of engineering, except aircraft, and is, of course, the home of the world-famous arsenal.

It may very well have been the arsenal that drew Quintin Hogg, father of the polytechnic movement, to open a polytechnic at Woolwich in 1890. A boys' school, housed in the main polytechnic building, was opened in 1913, passing successively through the phases of a trade school, a junior technical school and, under the Education Act of 1944, a secondary technical school. In its present form, the role of the school, in common with others of its kind, is to provide mainly a good general education, but with some bias towards vocational training, keeping in mind the modern demand for technologists rather than simply mechanics.

The polytechnic has very close ties with the arsenal and large numbers of part-time day students attend on two days a week from the Royal Ordnance factories. The sandwich scheme, whereby periods in industry alternate with periods in college, was first operated between the arsenal and the polytechnic, and this contact with industry now includes many famous local firms, some of which are represented on the governing body of the polytechnic.



Equipment is comprehensive, but students do not go on to machine tools until they are reasonably competent and " safe "

The total strength of the boys' school is 376 pupils, of whom 260 are studying engineering. The number admitted annually to study engineering is 96, from an average of 200 applications from the London area and others from Kent. This is an excellent indication that the apathy which appears to be leaving places unfilled in some engineering schools is certainly not affecting competition to enter Woolwich, which clearly enjoys a high reputation with local parents.

First-year entrants (boys aged 12 years 11 months to 13 years 11 months) are graded and then for the next two years are divided into three groups. Group A, the smallest, is the examination class which takes the General Certificate of Education examination at the end of the third year, when an average of two-thirds are successful, some showing outstanding ability. In addition all boys take the first year examination of the ordinary National Certificate and a high percentage are successful.

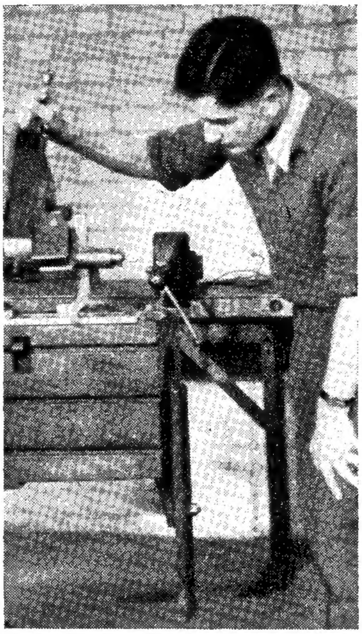
This effort to ensure that the boys obtain this first-year certificate is an extremely important feature of the work of the school, as many schools are content to award their own certificate of proficiency which depends to a large extent on their own evaluation of the boy's progress. By this means pupils at the

polytechnic are enabled to enter employment with a definite recognised qualification which many boys receive only at the end of their first year of apprenticeship.

The primary purpose of this article is to give an idea of the engineering training provided at the school, but it will be appreciated that this aspect of education is but one phase of a very efficient general education. Every engineering pupil receives practical instruction for a half-day per week in workshop practice, including a ¾-hour theoretical lecture. All the instructors have had experience in industry and this ensures that the work done by the boys will be of real value to them when they enter industrial life. The aim of the instructors is to ensure that the boys obtain the right idea of using their brains and their hands. They are shown how to set up their machines and how to make the first cut, but after that they are expected to do things for themselves and to consult the instructors only when they are in real difficulty. Likewise the instructors avoid giving them work which is purely an exercise, but suggest some useful article which will involve practice in marking out, working, and fitting to size.

Thus the articles made in the first year are selected from the following list; a keyhole plate, spanner, pin tray (involving soldering and tinplate bending), centre punch, picture hook, engineer's square, hasp and staple (introducing wire-bending and plate-bending), and a tap-wrench. The list for the second year comprises a gate handle, tool clamp, cold chisel, forged gate hook (all hammer work), shackle and pin (a turning exercise), and also outside calipers, inside calipers, and an odd-leg caliper. The third year articles include a large square, trammel bar, adjustable tap-wrench, depth gauge, hacksaw frame, scribing block, vee-block and clamps, and a bench vice, which involves machining a supplied cast block. As far as possible a domestic item is included in their work as it has been found to give tremendous encouragement to a boy's progress if he takes home an article which he has made with his own hands.

In the workshop all the boys are in one group as it seems that there is no direct connection between their scholastic grade and their ability to use their hands—in fact, if anything, it is the least academic boys who show the most ability in the workshop. The very large machine shop, although not daylit, has light-coloured walls, whilst extremely good illumination is provided by fluorescent lighting. The lighting on machines and benches is bright and shadowless. There is ample bench accommodation for fitting, and the workshop is very well equipped with three bench drills, two tool grinders, 14 lathes (five are 4 in., six are 3-in., and three are 9-in.), each of which has an individual drive. There is also one vertical milling machine, one universal miller, one horizontal miller, one radial drill, one surface grinder, a rotary grinder, and two power saws.



Work becomes really interesting for the advanced student

Experience has shown that there is no apathy among the boys. They love the practical work and, in the words of one instructor, will do anything rather than miss it. Their favourite subject is machine work, but they tend to dislike heavy fitting. The subjects taught during the theory period include the description and use of tools and details of workshop machine tools and other processes such as soldering, brazing and blacksmithing.

Although, as was mentioned earlier, most of the school subjects are to provide a general education, there are some which are directly or indirectly allied to the engineering teaching and these include mathematics, mechanics, engineering drawing (which is a half-day session per week), physics, and chemistry.

Instruction in carpentry is also provided. At one time this consisted largely of making wooden patterns for iron moulding, but with the increased industrial use of plastic in place of wooden patterns, the boys are now allowed to make useful household articles, such as lamp standards and book cases, which give them the necessary practice in manual dexterity and the feel of tools in a much more interesting way. At the same time they are developing skills which can be applied in a variety of ways in employment. Many of the boys are keen model makers in their leisure hours, and of course their general engineering training gives them skill and enthusiasm above average.

Model engineering is also represented in the spare-time activities of the school itself by a model aero-club run by the chief instructor. The boys make the models themselves, with the instructor in the role of consultant and also that of organiser of occasional competitions with prizes purchased from the small subscription charged to members. They have also assisted the instructor to make a 30-in. model of a river-type launch driven by a 2 c.c. diesel engine, water-cooled and silenced. The instructor intends that the launch shall be radio-controlled. It is interesting to note that he has found that the engineering knowledge gained by the boys during school hours is helpful in model-making rather than the other way about.

During term-time the boys make visits to such local firms as Standard Telephones, Harland and Wolffs, Associated Motorcycles, G. A. Harveys, Pitter Gauges, Green and Silley Weir, and, of course, The arsenal.

The polytechnic has its own playing fields which the boys visit for a half-day per week for rugby, soccer, hockey, cricket, tennis, and athletics (field and track).

A high proportion of the boys enter local industry as apprentices and are then sent by their firms to attend the Polytechnic Senior College for part-time day classes. Thus the polytechnic provides their education from the beginning of their technical school career until the time comes for them to pass their final examinations. It is, therefore, able to provide local firms with boys who are trained to suit their requirements. It is, however, not merely to local firms that they are supplied for the students have also been accepted by such bodies as the G.P.O., British Electricity Authority, the Gas Board, the R.A.F., the Merchant Navy, and many other similar organisations.

L.B.S.C.'s

"NETTA"

A NORTH-EASTERN T-CLASS "MITEY" HAULER IN FIVE GAUGES

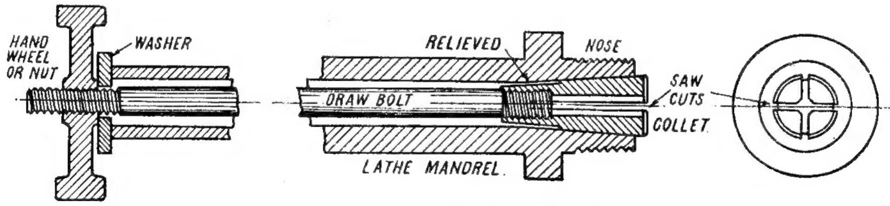
PURSUING the policy of giving separate dimensioned drawings for small components, with the approval of our friend the K.B.P., here are some showing the complete range of crankpins and eccentrics, for the whole family of quins. I did have a shot at reducing the number of illustrations; but the awful array of figures, when trying to make one illustration serve for two or more sizes, looked so confusing and bewildering that I decided it would be much easier to draw them out separately. This cuts out any risk of builders getting mixed up with the various measurements. By the way, the blueprints for this job will be made up into five separate sets, one for each gauge, which will simplify matters still further for those who build the engines from the prints; and this will enable further detail to be included in each set to make them as complete as possible.

Now for a word to the wise. If your three-jaw chuck is reasonably accurate, the crankpins can be turned from silver-steel of requisite size, as the "natural" finish on this material gives long life without undue wear, and it runs with very little friction in the bearings. However, many readers have raised awful moans about their so-called "self-centring" chucks, saying that they are anything but that; and when they have taken my advice about making a split bush to ensure accuracy for chucking piston-rods and similar pieces truly, another trouble has arisen. When the split bush has been removed, and replaced, it runs all wibbly-wobbly due to the chuck jaws not closing in as they did when the bush was made. The cause of this is probably a worn scroll, as the jaws are usually hardened; they are on my chucks, anyway. The best way for these unlucky wights to cure their troubles for good and all time is to make a few collets for holding "precision" jobs; and that is another thing that is easily done. Here's how:

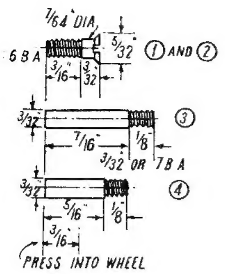
For each size of collet required, you'll need a piece of round mild-steel a little bigger than the end of the taper hole in the mandrel nose. Chuck it in that bluepencil three-jaw, and turn about $1\frac{1}{2}$ in. length, to fit the taper hole. If your top-slide isn't graduated, it can be set before chucking the rod, by putting a taper-shank drill in the chuck, taper outwards, and adjusting the top-slide so that a tool in the rest will touch the taper shank for its full length when the handle of the top-slide is turned. As you have to take Ananias the chuck off the mandrel nose to try the taper in the hole, don't take the bit of metal out of it when testing. When it fits exactly, replace Ananias, still holding the bit of metal; face the latter, centre it, and if the lathe mandrel has a hole through it about $\frac{1}{2}$ in. diameter, drill a hole in the end of the tapered metal, about $\frac{1}{2}$ in. deep, with a 9/32-in. drill. Tap this $\frac{5}{16}$ in. $\times$ 32 and part off the taper, which now becomes an embryo collet.

Next, cut a piece of $\frac{5}{16}$-in. steel rod to approximately the same length as the lathe mandrel. Screw about $\frac{1}{2}$ in. of one end to match the tapped hole in the taper piece, and about 1 in. of the other end with a $\frac{5}{16}$-in. Whitworth or B.S.F. die. Screw the shorter end tightly into the taper piece. Poke the rod through the hole in the mandrel, until the taper seats home. Face the end, centre, and drill down with a drill about 1/32 in. smaller than the exact size of the required hole in the collet, until the drill reaches the end of the rod. Then, with a weeny boring tool, which can be made from the tang end of an old file, bore the hole until a bit of steel rod or a drill-shank of the required size fits the hole exactly. If you try to drill and ream to finished size, it is a million dollars to a pinch of snuff that the hole will be just a shade out of centre, and the collet will be merely a relation to Ananias.

Remove it from the mandrel, and carefully make two cross saw-cuts down it; file off any burring left by the saw, but don't on any account let the file cut into the taper. Chuck in three-jaw by the rod, with the collet projecting beyond the jaws, bring up the tailstock centre to support it, and slightly relieve the taper from just above the sawcuts to the end of the piece. This forms the clearance that allows the collet to be drawn into the taper hole, and close in on the rod that it is holding, thus gripping it securely and truly. The collet can then be replaced in the hole in the mandrel and any burr left by saw-cutting in the hole carefully cleaned out with a reamer, drill, or D-bit held in the tailstock chuck. This should be the exact size of the hole, so that it doesn't enlarge it. All that then remains is to put a nut and washer on the end of the rod projecting from the tail of the mandrel, and Bob's your uncle once more. You can take the collet out of the mandrel and put it back as many times as desired, and it will always hold dead truly, the size of rod suiting the hole.

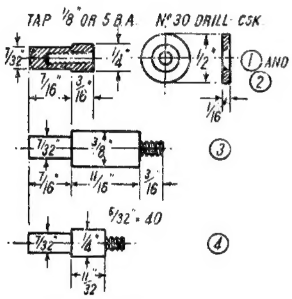


Section of the home-made collet



Gauge "O" crankpins

For quick operation, a small hand-wheel could be made from a discarded or odd-size locomotive wheel casting, with the flange turned off, and the boss drilled and tapped to screw on to the end of the long rod or drawbolt as it has become. The above is, of course, stale news to old followers of these notes; but so many beginners have asked for a

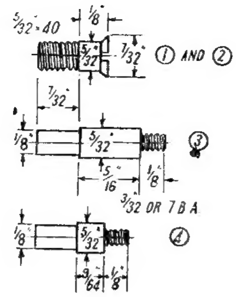


3½-in. gauge crankpins

means of chucking truly, when their chuck is a you-know-what, that I thought it would be worth repeating.

Crankpins

Starting with the baby quin, the crankpins for this are the simplest ever, the driving and trailing pins being merely pieces of 3/32 in. round silver-steel with a few threads on the end, as shown. The leading and intermediate pins are turned from 5/32 in. mild or silver-steel. Chuck in three-jaw—or collet, as above—face the end, and turn down ¼ in. length to 7/64 in. diameter with a pointed tool, the sharp apex of which has been very slightly rounded off on an oilstone, just enough to prevent it cutting scratches. Screw 3/16 in. of this with a 6-B.A. die in the tailstock holder. The threads should be tight, to prevent them coming loose when the engine is running fast. The holes in the bosses of the leading and second pairs of wheels are, of course, tapped to suit. The pins in the third and fourth pairs of wheels are pressed in, using the bench vice as a press, putting a brass nut on the threads to prevent them getting damaged. If the blank ends of the pins are slightly eased with a file to enable them to start easily in the holes, they should press home nicely without any risk of splitting the wheel bosses. The screwed pins should be parted off to leave a countersunk-type head as shown, and slotted with a fine saw.

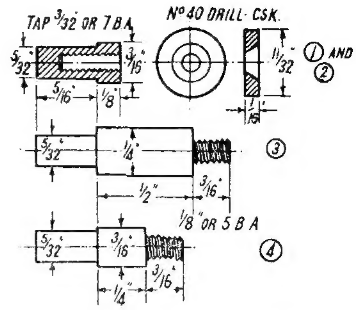


1¾-in. gauge crankpins

The leading and second pins for the gauge "1" engine are made in similar manner, but from 7/32-in. steel. The driving and trailing pins are made from 5/32-in. silver-steel, and have a spigot turned on them for pressing into the hole in the wheel boss. I've already explained umpteen times, how any raw recruit can turn spigots to press fits without the least trouble, so there is no excuse for splitting the wheel bosses, nor having loose pins. However, it would be a clever merchant who didn't have an occasional misfit, so if by chance you find one a wee bit easy, burr over the projecting end of the spigot on the inside of the wheel, just sufficiently to prevent it from coming out on the road, or from turning in the wheel when the nut is tightened up.

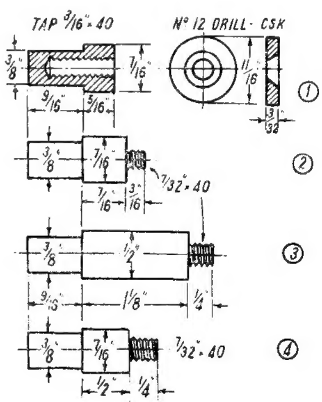
Variations for Larger Sizes

The larger sizes differ a little from the smaller, inasmuch as the leading pin is furnished with a retaining washer, held by a screw in a tapped hole in the pin itself. This is necessary, because any projection beyond the boss of the coupling-rod, would run foul of the crosshead. On the full-sized engines, the boss of the rod would only clear the crosshead when the latter was at the extreme end of the stroke, and this was the cause of an amusing incident in the Kaiser's war. The late Driver Bill Irvin was running



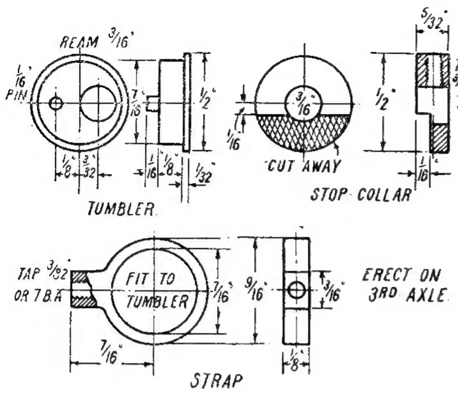
2½-in. gauge crankpins

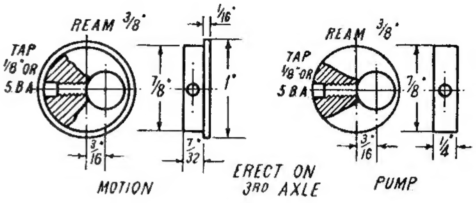
one of these engines in France, when the front section of the right-hand rod broke. Bill made his stop all right, and when the officer in charge, an inexperienced youngster, came up to find the cause of the stop, Bill explained. The officer told him to take off the corresponding section of rod on the opposite side, and proceed. Bill said the crosshead would foul. The officer said: "Nonsense," and told Bill to obey orders. Bill said, "O.K., but I'm not taking responsibility for the consequences." With the aid of the fireman and a couple of the Tommies on the train, the bit of rod was soon removed; Bill got up into the cab and opened the regulator. The load was heavy, and with one pair of wheels less to get a grip, the engine



5-in. gauge crankpins

"lost her feet," and—CRASH ! The leading crankpins and wheel bosses now being out of step with the crossheads, they hit, smashed the pins, damaged the crossheads, and bent the connecting rods. Up came the officer again, and Bill said to him: "There you are, now you'd better give me the sack !" Poor Bill—he was a "real lad." On the small quins, I am arranging



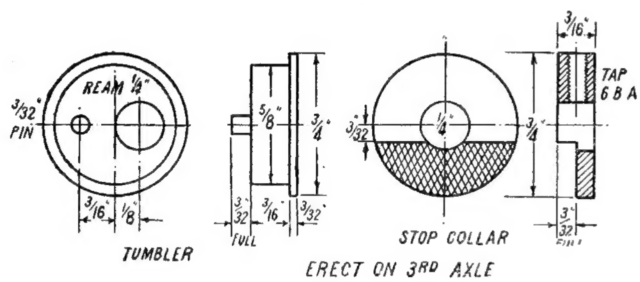


2½-in. gauge eccentrics—valve-gear and pump

Left—Gauge " O " loose eccentrics and stop-collar

matters so that the crossheads don't foul in any position.

The pins are made in the same way for 2½-in., 3½-in. and 5-in. gauges. Chuck a bit of steel of the size given, turn the spigot, and part off enough to form the " head." Reverse in chuck, centre, and drill and tap for the pin. To avoid breaking the tap (they break very easily when tapping blind holes in silver-steel) put a tap-wrench on the shank near the threaded part, and hold the tap in the tailstock chuck, with the jaws just slack enough to allow the tap to slide. Then, if you hold the tap-wrench with your fingers, and work the belt up and down by hand, a weeny bit at a time, you can feel if the tap is " going hard," and take precautions. Use plenty of cutting oil on the tap.



1¾-in. gauge loose eccentrics and stop-collar

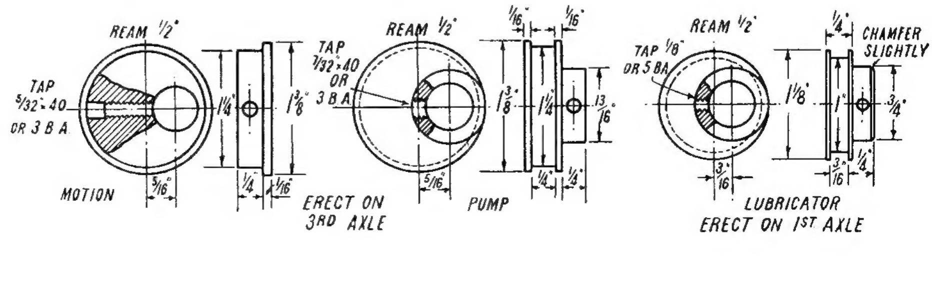
The washer is merely a slice parted off a bit of mild-steel of given size, held in the three-jaw. Drill and countersink the hole before parting off. In the 2½-in. and 3½-in. sizes, a similar pin is used for the second wheel. In the 5-in. size, the intermediate pins are the same pattern as the trailing pins, but a little shorter.

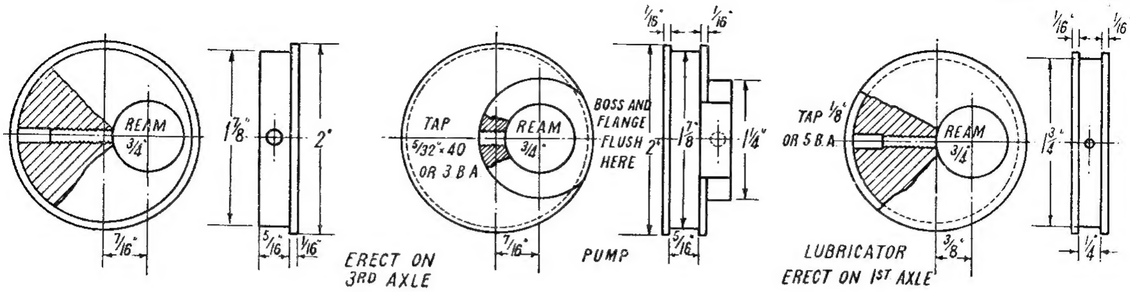
Note that in all three larger sizes, the driving pins are of greater diameter than the rest. All sizes are given in the illustrations, and no further details should be needed for merely plain turning jobs. Put brass nuts temporarily on all threaded ends when pressing home the pins in the wheel bosses, to prevent damaging the threads.

The eccentrics are all made in the same manner, whether large or small, from mild-steel rod of the diameter over flanges. Chuck in three-jaw, and for those with single flanges, turn to length and diameter shown in the drawings, with a knife tool, the point of which has been oilstoned off just sufficiently to prevent the tool leaving a scratchy surface. The bearing surface should be as smooth as possible, to avoid undue wear of the straps, and avoid friction. Iron castings may also be used for the larger sizes, and these should have a chucking-piece cast on. When parting off from bar, use a tool with a fair amount of top rake, and slop on plenty of cutting oil. My lathes part off without chatter, the cutting coiling up like a spring, with a sound like bacon frying; but the smell isn't as appetising !

The end of the rod should be faced truly in all cases. The groove in the double-flanged eccentrics can also be cut with a parting tool. If your lathe chatters when parting or grooving large diameters, and careful adjustment of the bearings and slides won't stop it, try taking the last scrape off the bottom of the groove, pulling the belt very slowly by hand, with plenty of cutting oil applied to the tool. That usually does the trick. If the part-off side appears convex, which it sometimes is, due to the spring of the parting-tool, chuck with that side outwards, and face off truly.

3½-in gauge eccentrics





5-in. gauge eccentrics

The facing tool will show the true centre; and from that, the eccentric centre (says Pat) can be marked off. The holes for the axles *must* go through dead square with the sides; and the best way to ensure that, is to chuck them in the four-jaw with the pop-mark running truly, and centre, drill, and ream, same as for wheels. Tip: When doing two or more of similar size, such as the motion eccentrics, only one need be marked off. After performing the drilling and reaming, slack jaws 1 and 2 of the four-jaw; remove the drilled eccentric, put another one in, and re-tighten the same two jaws. The second one will then be in exactly the same chucked position as the first and can be centred, drilled and reamed right away, no centre-popping being required. I have one of those very useful universal chucks which is operated by two keys, one moving the jaws independently, and the other together, so all I have to do when rechucking eccentric sheaves for drilling, is to use the second key. All jaws then come back to the same place. Time is precious nowadays !

The pins in the loose eccentrics are merely bits of silver-steel, of sizes shown, squeezed into holes drilled in the sheaves; No. 53 drill for $\frac{1}{16}$ in. and No. 43 for 3/32 in. When drilling the holes for setscrews in the thicknesses of the fixed eccentrics, drill a little way down with a clearing drill, as shown. Allen screws should be used wherever possible; but as these are not available in all localities, ordinary grub-screws can be used, home-made from silver-steel, the points being hardened. The clearing hole allows a screwdriver with a blade the full width of the slot, to be used for tightening. The slot is less likely to burr than by using a screwdriver blade in a tapped hole.

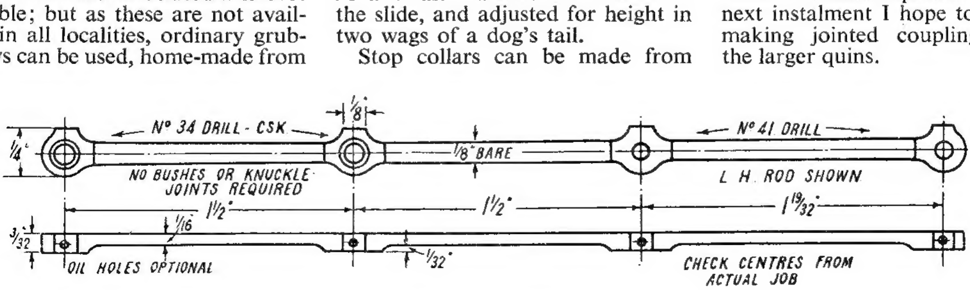
For the eccentrics with bosses, chuck the rod, face off, form the groove, and then part off at sufficient distance from the groove, to form both flange and boss. After drilling the axle hole, mount the eccentric, boss side outwards, on a stub mandrel held in three-jaw, and turn the boss with a knife tool. Don't take too greedy a cut at each traverse, or the embryo eccentric will shift on the mandrel, and you might emulate one of my munition girls named Jewel, who often "knocked the tip off the tewel."

For stop collars, chuck a piece of rod of size required, face the end, centre, and drill a little deeper than thickness of collar. Part off to full thickness, reverse in chuck, face off the parted side truly, and poke a reamer of size indicated on drawing, through the drilled hole. The segment can be milled out in exactly the same way as the grooves in axleboxes are machined, viz: clamp the collar, on its side, at correct height, under the slide-rest toolholder, and traverse across an end-mill or slot-drill held in the three-jaw. This is one of the many jobs where a vertical slide proves invaluable, as the collars can be held in a small machine-vice bolted to the slide, and adjusted for height in two wags of a dog's tail.

Stop collars can be made from either steel, cast-iron, bronze or gunmetal, or even brass, as the only place where wear occurs is at the point on the face where they drive the pin in the eccentric. Note that the eccentrics for driving the lubricators, on the $3\frac{1}{2}$-in. and 5-in. locomotives, are thinner than the others. This is because it is a bit of a squeeze to get them in between the pump valve-box, and the valve-crosshead, which is inside the frame. Incidentally I've a nobby collection of what Crewe calls "development drawings" already, as I'm trying my best to avoid leading builders "up the garden." They take an awful time to get out, but save a lot of trouble when fitting bits in; the good folk who build my engines very seldom have trouble with oddments getting in each other's way. The $2\frac{1}{2}$-in. gauge lubricator will be driven off the motion, as there isn't room for a separate eccentric. The little quins will have hydrostatic lubricators.

Gauge "O" Coupling-Rods

As the baby quin isn't sprung (not necessary for a weeny thing running on a "scenic" road) the coupling-rods need no joints, each being made from a single piece of steel 3/32 in. thick and $\frac{1}{4}$ in. wide. This is just a plain sawing, filing and drilling job, and anybody of average gumption should be able to make them straight from the drawing without detailed explanation. In the next instalment I hope to deal with making jointed coupling-rods for the larger quins.

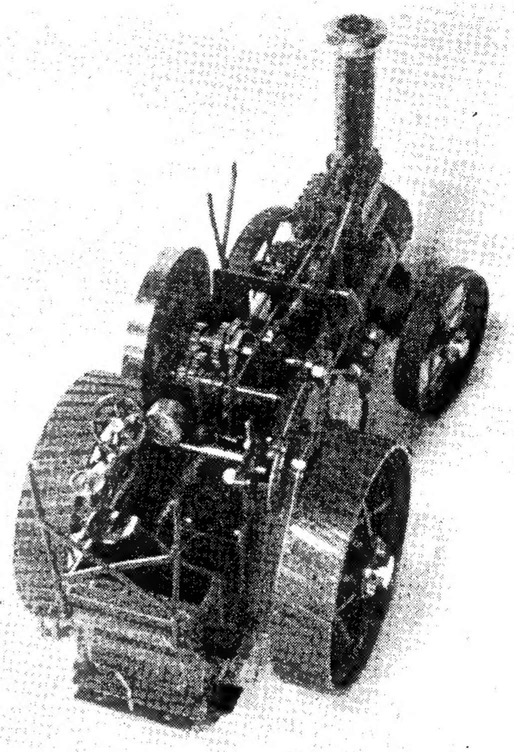


Gauge "O" coupling-rods

ANOTHER ONE-INCH SCALE

"M.E." Traction Engine

By J. Dainton



THE engine which I have completed has been more or less to the late Mr. Henry Greenly's "words and music."

The model occupied some fourteen months of spare time, and my first attempt at serious model making has proved a very interesting experience. I find I have still much to learn about steam and valve-gears, etc.

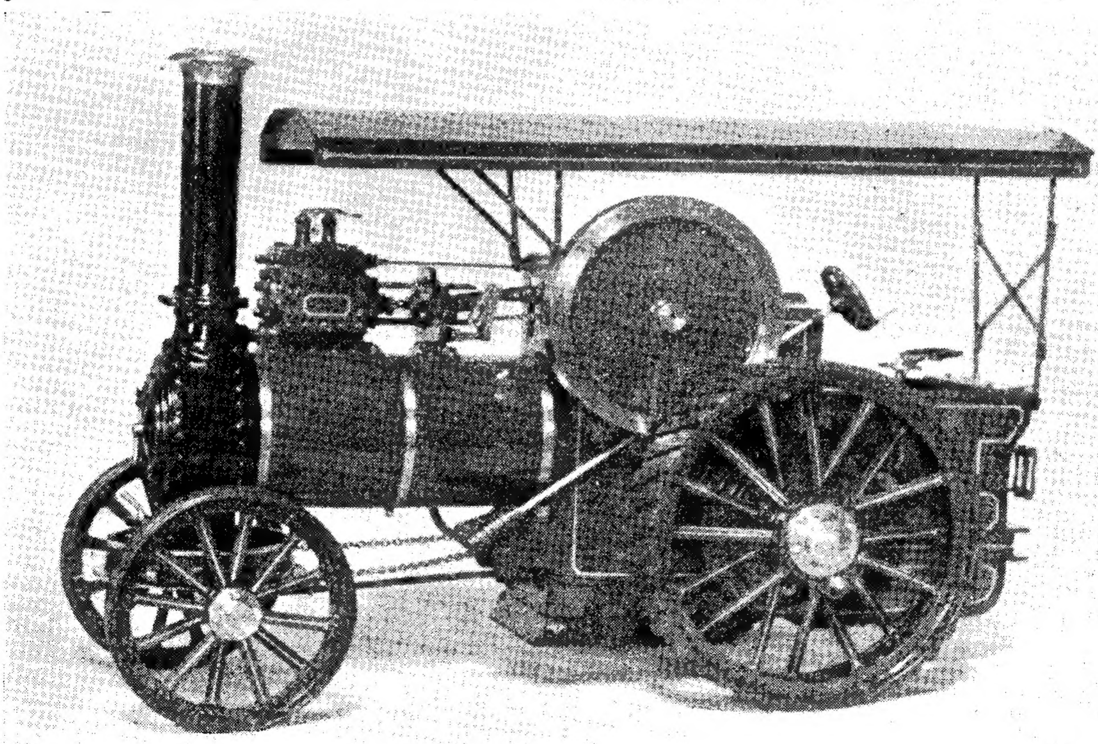
Additional to Mr. Greenly's specification are a compensating gear on the rear axle, a water-gauge to "L.B.S.C." specification, and a reverse lever with trigger and notched quadrant.

The cylinder is bored to $\frac{11}{16}$ in. diameter, is linered and steam jacketed.

All machining was carried out on a $3\frac{1}{2}$ in. centre lathe with $\frac{1}{4}$ h.p. motor, the only exceptions being the spur gears which were bought ready cut, and the bevel gears, ex-aircraft gun-turret gears, for the compensating gear.

The model has been tried out under steam, and has pulled my young daughter quite easily.

When I started this model, I was lucky enough to be able to borrow the back numbers of THE MODEL ENGINEER dealing with its construction and so began my acquaintance with the journal.



HOW TO MAKE TURNING A PLEASURE

By F. L. Leightwood

THERE can be little doubt that one of the greatest attractions in model engineering is the pleasure derived from operating the lathe. The importance of the lathe in the home workshop can easily be judged by the number of lathe ads. in THE MODEL ENGINEER, and such photographs which appear from time to time of workshops always feature the lathe.

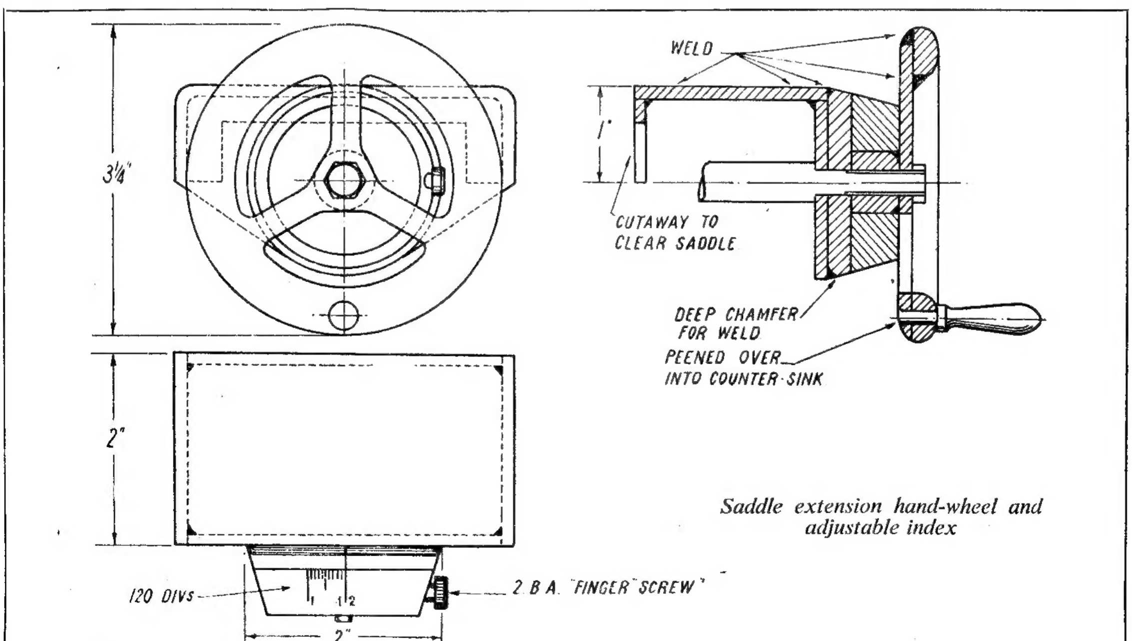
There is, however, a very big difference between the simple back-gear lathe of the home workshop and the complicated machine in the factory, and although it is not essential that the small lathe should be similarly equipped, the time spent in making such items as a slow-feed for self-acting, indexes, screwcutting dials, etc., is in my opinion time well spent. My lathe when new, was the rock-bottom of simplicity and I soon decided that it was too simple for my liking. The first item I made was a simple index for the cross-feed. This I engraved with 120 divisions which meant an error of 0.005 per rev., but I could not set my change wheels up to cut the correct number. The error is so small, however, that I have never noticed it, while the advantage of having an index was ample reward for the time and trouble taken.

The lucky ones who own an M.L.7 have as part of their lathe the next modification that I made. I refer of course, to the extension in front of the boring table. When I had my top-slide set in a position suitable for turning small diameter work, the boring table was almost hanging off the saddle by the time I withdrew it sufficiently to turn a diameter of over 4 in. Another thing I did not like was the way the recess between the slides became filled with swarf when the boring table was in this position. The extension I made, as shown in the drawing, fits the full width of the boring table and the lower edges of the sides just clear the saddle, thus covering the slides completely under all normal circumstances and allowing 2 in. further "safe" cross traverse.

For a while I was quite content with my lathe and so I carried on with the Aveling-Barford diesel roller. However, after rough turning the hind-axle, I decided I would have to do something about this self-acting which required so many change wheels. The best I could manage was about 0.008 in. per rev. and changing over to screwcutting needed a strong will, especially when I knew I should require the self-act soon afterwards. The solution to the problem was the worm gear I described some time ago and with a feed of 0.002 in. per rev. the axle was finished, requiring very little polishing to remove the faint tool marks.

By now I was beginning to enjoy using my lathe, but the need to change the lathe tools for each operation could be quite annoying at times, especially when a tool had to be taken out of the clamp and another set for a cut which took a few seconds only, then re-set the original tool, so when I was offered a nice square block of steel, I accepted with both hands.

In order to remove as much surplus metal as possible before milling the slots, I marked out their position and also the height of the tool-box. Rows of 5/32 in. holes were then drilled ½ in. deep inside the lines for the slots and also three



Saddle extension hand-wheel and adjustable index

more in about the middle of the slot from the ends of two of the slots. The rows of holes were then sawn down, thus leaving only the metal between the long holes in the bottom of the slots to be broken away with a cross-cut chisel. The other two slots were then drilled down and cut out the same way. The surplus on the top was dealt with in a similar way by drilling a ring of holes around the raised portion (normally a loose washer) and then drilling in to meet them from the four sides. In addition, two rows of radial holes are required to assist the breakaway. Incidentally, all this metal removing was done chiefly because I only had a treadle at the time, and to mill and turn the metal away would be a long job.

To complete the job the " lever " nut was made and so I now have a roughing tool and a finishing tool permanently set with two other slots for any other tools I require from time to time.

When one day I found a steel disc 4 in. diameter by $\frac{5}{16}$ in. thick, the centre being " dished," it struck me that it would make a neat handwheel for the rack traverse gear. This was drilled and tapped $\frac{5}{16}$ in. Whit. (in the lathe of course), and the outer edges radiused away. Three spokes were marked out on the dished portion and the surplus metal cut out by drilling, sawing and filing. Two $\frac{5}{16}$ in. holes were tapped in the rim, one for the handle and the other for a screw, the idea being that an extension handle could be fitted across the wheel for gear-shaping in the lathe, or any similar " unorthodox " operation.

Fitting the handwheel converted what had hitherto been an almost useless appendage into a useful control, for feeding by hand had to be done through the leadscrew up to then. This decided the fate of the other two ball-handles and so when a ring of steel $\frac{1}{4}$ in. square, came into my possession it was ear-marked immediately. A piece of 10-gauge plate from the scrap-box was cut $\frac{1}{4}$ in. smaller and clamped in position for welding, and a block was also welded on the other side of the plate, as shown in the drawing, to carry the adjustable index which I had decided to fit. This latter is also graduated in 120 divisions, but being of somewhat larger diameter than the old one, the graduations are further apart and being adjustable, adds, of course, to its utility. For the leadscrew, I am not quite sure what to do, as I rarely use it nowadays for hand-feeding, and all I use a handle for is to bring the tool up to the start of the cut before engaging the worm-drive.

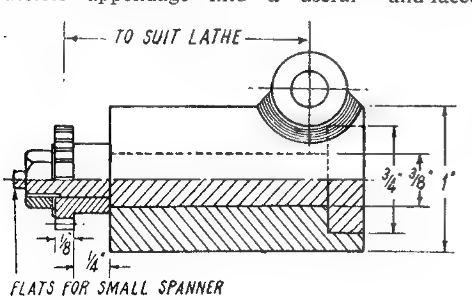
Well, my roller isn't getting built but who cares ? I've got years to build it in, so what's wrong with another weekend devoted to the lathe ? I've always wanted a screw-cutting dial. Somehow, they intrigue me; maybe it is the way the dial sneaks around in the body as the leadscrew turns, or perhaps it is the way the turners in the factory stand poised like a bird of prey watching for the mark to come round before they pounce on the handle of the split-nut. Anyway I think screw-cutting without one is not worth it, when for the sake of an hour or two, one can make a perfectly serviceable indicator; mine was made between lunch and tea on a Sunday afternoon; fitted and tested, too ! The body was welded up from two pieces of steel, the smaller piece being drilled $\frac{1}{4}$ in. and faced to length prior to welding. A groove was filed in the main part of the body to accommodate the smaller piece and the two welded right round the joint.

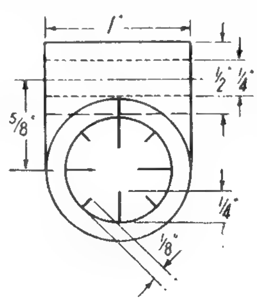
When cooled off, the welding was dressed up with an old round file until all the roughness had been smoothed off. As this is in view all the time, any unsightly welding would spoil the whole lathe. The body was then mounted in the chuck, top face out and this face cleaned up, centred and drilled out to 23/64 in. followed by a $\frac{3}{8}$ in. reamer (or a D-bit if you use one). The counter-bore was next opened out to $\frac{3}{4}$ in., taking care to get a good face in the bottom with clean, sharp corners and a small chamfer between the $\frac{3}{8}$-in. bore and the inside face to clear the radius under the head of the dial. An old $\frac{1}{2}$-in. bolt was pressed into service for the dial, as I would then have less to turn down, although $\frac{3}{4}$ in., or better still, slightly bigger bar would do nearly as well. The bolt was held by the head in my (then only) 4 in. 4-jaw chuck, two flats having been filed on opposite corners to allow all four jaws to grip, and the stem was turned to a nice free-running fit in the body and the face under the head cleaned up. The lower end of the spindle was turned to $\frac{1}{4}$ in. diameter, and screwed for the lock-nut as shown on the drawing.

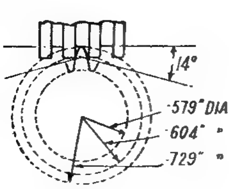
In order to turn the head, the spindle was next mounted (wrapped in shim-brass) in the chuck (I *must* get a 3-jaw) and after careful setting up, the head was turned down to fit the body and thinned down until the face was just flush. The engraving was carried out in the " Duplex " manner with a 40-tooth change wheel using every five teeth to give eight marks. These are quite sufficient really, but I wish now that I had gone the " whole hog " and engraved 16, as when using the lathe for self-acting, the odd marks would be a slight help, though there is not much in it really, as they can be judged fairly accurately.

Whilst I was on with the engraving I realised I had forgotten the zero mark on the body and so I had to re-set the body in the chuck after giving the head a final polish. The mark was simply engraved by locking the mandrel with the mounting boss vertical, being set with a square off the boring table.

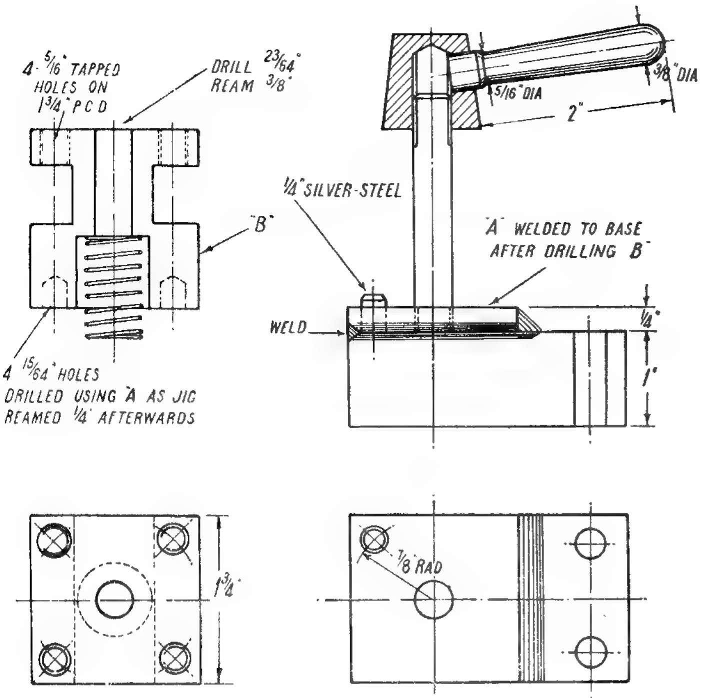
As I stated when indexing the head for the engraving, I should have used 16 divs., i.e. one for each tooth on the pinion, as the pinion is 2 in. in *circumference* on the pitch-circle, thus the three diameters concerned are 0.604 in. + 0.125 in.







Details of the screw-cutting indicator

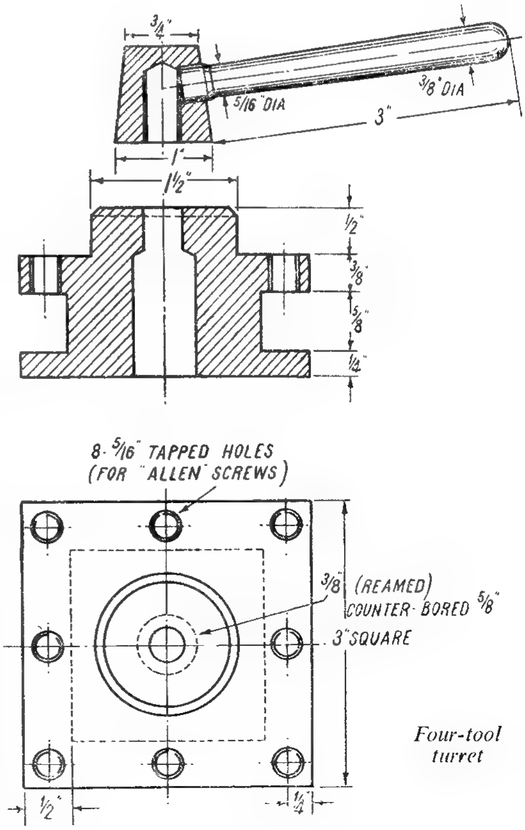


Indexing rear toolpost

— 0.125 in. for pitch outside and root diameters. (Please don't anyone write and say I am all wrong—the thing works fine.) The pinion is best, I think, when made of some soft material like soft brass, or possibly even aluminium, and so I used one of my very few bits of brass bar for mine. This was first turned to the outside diameter and the recess cut with the parting tool. The gear-shaping process was carried out with a tool which though theoretically is incorrect, is nevertheless sufficiently accurate if made carefully. In order to get an idea of the shape, I first drew up an enlarged view of two adjacent teeth and then copied this in the correct size, using simple curves for flanks of the teeth. By comparing the two sketches, I could see no error and so, drawing a line out from the centre passing exactly between the teeth, I cut a template in tinplate and shaped one end to fit exactly between the teeth, keeping the line on the drawing down the centre. This was then used to grind a tool up from a piece of an old $\frac{1}{4}$ in. square file. This was then mounted in the tool-box and set to centre-height, and the 16 teeth shaped out to 0.005 in. short of a full turn of the cross-feed screw, (0.115 in. on my index) to provide sufficient clearance between the tips of the teeth and the root of the thread in order to allow for wear, the teeth, of course, being proportionately thicker than "size." To complete the pinion, a light facing cut was taken over the ends of the teeth, the 1-in. hole drilled and reamed and then parted off the bar.

A trial run up and down the leadscrew holding the pinion between the fingers on a short piece of $\frac{1}{4}$-in. bar, seemed all right; it was a little rough in places due to uneven wear on the leadscrew, but there seemed little that could be done about that, so the unit was assembled and held in position on the lathe. By sheer good luck the web at the edge of the apron was just right for drilling and tapping to take the mounting bolt, and so the position was marked off and the apron removed from the lathe for drilling and tapping the $\frac{1}{4}$-in. B.S.F. hole. After reassembling the apron, the indicator was bolted in position and set so that it engaged the leadscrew without undue backlash or "interfering," i.e. causing the screw to be pushed out of its normal position. The split nut was then engaged and the dial rotated by a small spanner on the flats below the $\frac{1}{4}$-in. nut until a line coincided with the fixed line, the nut being tightened at this. Several tries up and down the lathe showed that when any mark lined up with the fixed mark, the nut would engage smoothly, much to my delight.

By this time I was in a position to use an electric motor and this was duly mounted on an angle-iron column with the countershaft I had stored, but never been in a position to use, and my old treadle wheel consigned to the scrap-heap after removing all the useful bits and pieces. I was sorry in a way, but the pedal had many times caused me to utter harsh words in the



Four-tool turret

confined space of my 8 ft. by 6 ft. workshop and the motor *is* rather stronger than I am.

With the possible exception of the screw-cutting indicator, no item on my development programme proved to be quite so satisfying as the rear-toolpost. It seems ridiculous, the times that I have sawn work from the bar when for a few shillings' worth of steel and a few hours designing, machining, and fitting my trouble vanished. Just like that!

I used to try parting-off from the front, but at any speed, no matter how gentle or steady, steel bar just refused to play ball, and for no reason at all, suddenly, the mandrel would stop—and if the belt came off quickly enough the tool would be saved—if it didn't—well, the tool dealer has to live, I suppose.

I'd heard a lot about rear-toolposts and though some of the reasons given for their amazing superiority for parting and forming tools can be taken with a pinch of salt, I formed my own theory, based on the fact that not even cast-iron is 100 per cent. rigid, and the amount in my lathe is even more than that required in a 3½ in. centre-lathe.

My theory, which I have not heard of before, though no doubt it has been given by someone else at some time or other, is that, with a tool mounted in the conventional front-toolpost a line from the tip of the tool to the front edge of the top-slide would be at an angle leaning towards the centre of the lathe, consequently any downward movement of the tool tip results in the lifting of the rear of the top-slide—just a few "thou."—which causes an inward movement perhaps three to four times as great as the downward movement, thereby, increasing the cut, depressing the tool further until something gives way. With the rear-toolpost, however, the tool is *lifted* by the cut and, therefore, pulls *away* from the cut, thus clearing itself.

That is the theory I believe, and it seems to be borne out by the action of the tool, as now, I don't need to hesitate, in fact, I can even *force* the tool into the cut—here on Tyneside a tool for parting off is called a "ripping" tool, and I certainly see why now.

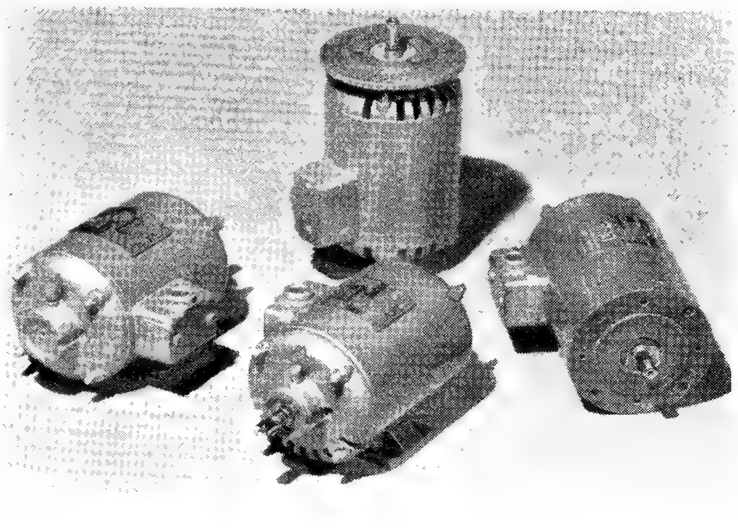
As to the construction of the tool a piece of 1⅝ in. bright square bar 2 in. long was chucked truly in the 4-jaw and faced, drilled 2 3/64 in. counterbored and reamed ⅜ in. for the pivot stud. The block was then reversed in the chuck and the top face cleaned up. While the chuck was still set, a square of ¼ in. thick bright bar was chucked and drilled and tapped in order that the stud would be vertical; incidentally, I hold taps in a 1 in. disc of steel held in the button-die holder, the disc having a square hole to suit the size of tap in use, a safer method than using the centre to support the tap or a large drill-chuck either. The position for the dowel-hole was marked-off before removing from the chuck and this drilled 15/64 in. or any suitable letter drill under ¼ in. This plate (*A* in the drawing) is then clamped to the block *B* with the edges level (the stud can be fitted and used with an ordinary nut for this) and the hole drilled into the block approx. ⅜ in. This is repeated at all four stations thus ensuring exact location of the holes. To complete the operation the holes are reamed out to 0.250 in. and a short length of ¼-in. silver-steel pressed into part *A*. The base is, in my case, 2 in. × 1 in. bright bar faced down to the same width as the remainder of the tool-post for appearance's sake, though the thickness may be varied to suit different lathes. Part *A* is welded all round, a deep chamfer being filed on three sides in order that the weld can be filed flush. The holes for the attachment screws are 21/64 in and the $\frac{5}{16}$ in. set-screws fit into tapped holes in a strip of ¼-in. bar in the "T" slot.

Milling the slots was done with a borrowed ⅝ in. end-mill (in about 1/20th the time I took to drill, chip, and mill the slots in the 4-tool turret) only two slots being required of course, the extra stations being used chiefly for setting the tools clear of the work when not required. A parting tool and a broad "V"-tool were constantly set ready for use, the "V"-tool being frequently brought into operation for chamfering corners, etc.

BROOK FRACTIONAL-HORSEPOWER MOTORS

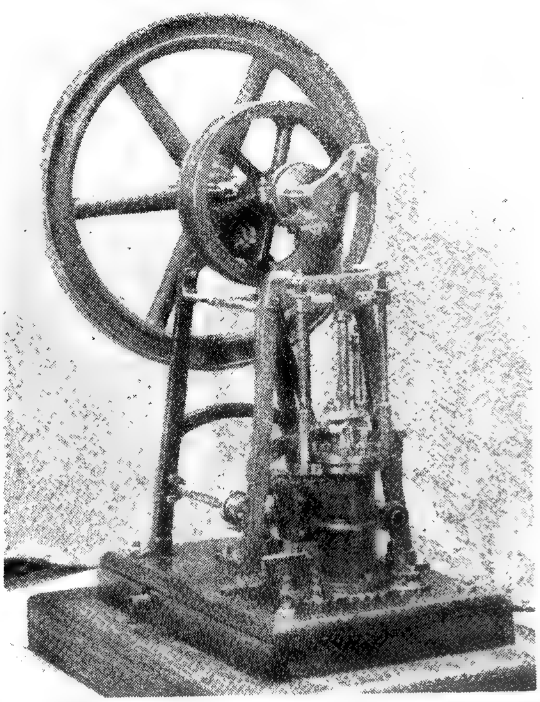
WE have received particulars of the latest types of Brook electric motors, which are suitable for small power machine tools within the sphere of the amateur workshop. The B.S.42 motors illustrated are made for a.c. supply, for voltages of 200 to 250 single-phase, and 400 to 440 three-phase, with various standardised forms of mounting, as shown. They are fitted with ball-bearings, with ring-oiled plain bushes obtainable as an alternative, and can be wound for speeds of 2,800, 1,380, or 880 r.p.m. on full load, with supply at 50 cycles frequency.

Power output varies according to type, the three-phase being capable of approximately twice the power of the single-phase for a given frame size. In the latter case, the starting windings are controlled by an internal centrifugal switch, so that they can be switched directly on to the mains. These motors are obtainable either totally enclosed or "protected" (partially enclosed and ventilated).



OVERCRANK TYPE STEAM ENGINE

By Fred Smith



THE engine about to be described was brought to me some years ago by Mr. Elliott, who at the time was engineer and surveyor to the Blackwell Rural District Council in Derbyshire. He told me it was built by his father, who was 18 years old in 1859, and was employed by the railway, at St. Pancras, London; and it may be a copy of some driving engine in the workshops. It is what is commonly known as an overcrank type and was generally used for factory driving, mortar mills, and I remember a similar one driving the colliery ventilating fan, about 1895, where I am employed. The engine was later removed and finished its days on a small coal screening plant, and was estimated to be about 15 h.p. I believe there are a few still running around the Nottingham district.

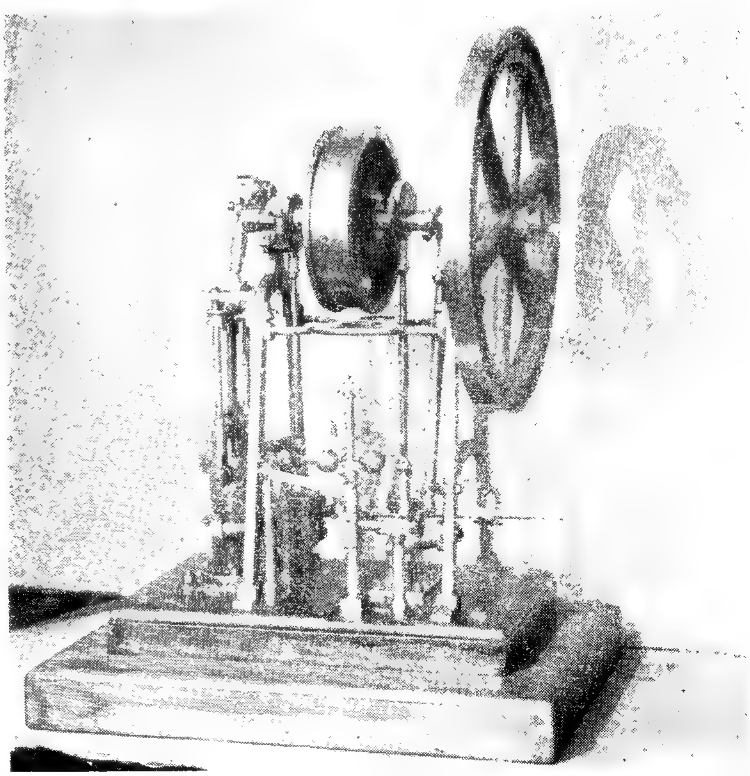
When I received the model it was very rusty and the working parts fast, and the two lugs at the top of the cylinder carrying the guide-bars were broken off. Also, the feet at the bottom of the main frames were broken.

I first carefully took the whole engine to pieces, and then repaired the broken parts by Sifbronze welding, and made a good job of them. The piston-ring was also worn very thin and I made a new one out of phosphor-bronze. As the cylinder top cover and gland were rather thick and ugly, I lightened these by turning off some surplus metal to bring them to proper shape. The steady bracket at the top of guide-bars was rather weak, so another one was cut out of a solid block of brass.

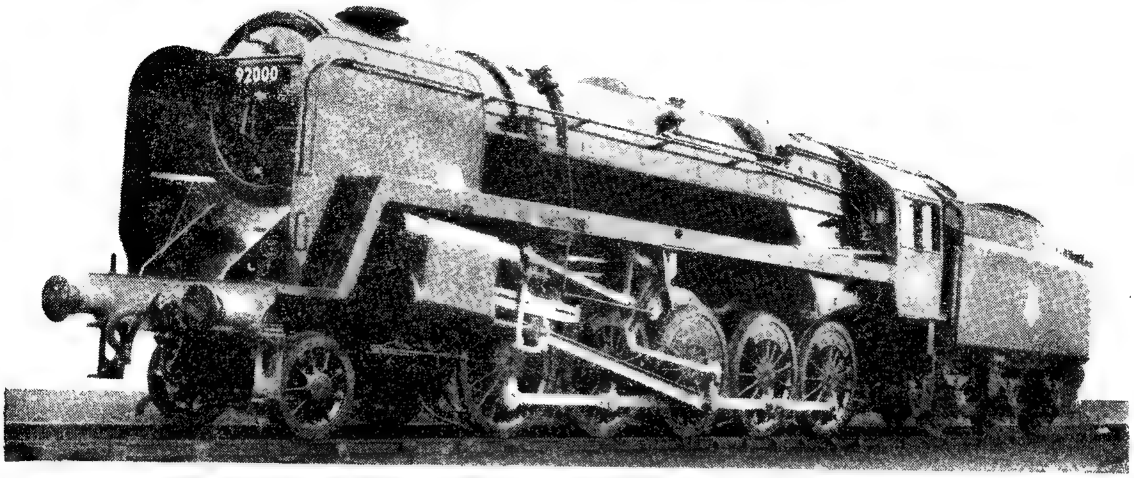
The whole engine is very complete, with a boiler feed pump driven by an eccentric from the crankshaft, also a proper Watt type governor positively driven through cut bevel gearing and acting on a butterfly throttle-valve in the main-steam pipe controlling the engine at 150 r.p.m. All wearing parts are fitted with adjustable brasses, gib and cotters at upper end of connecting-rod, and proper sliding nutted glands to the piston-rod and valve spindles respectively.

The whole engine is nicely made, the upright columns and base being cast-iron, and all moving parts are polished steel. The engine is not painted, as I consider the old blackening of the iron work, which it has gained in nearly 100 years, gives it a real old look

The chief dimensions are: Cylinder $1\frac{1}{8}$ in. bore, $2\frac{1}{2}$ in. stroke; flywheel, 10 in. diameter, crankshaft $\frac{5}{8}$ in. diameter. Cast-iron base, 10 in. × 8 in. Steam cut-off at 65 per cent. of stroke.

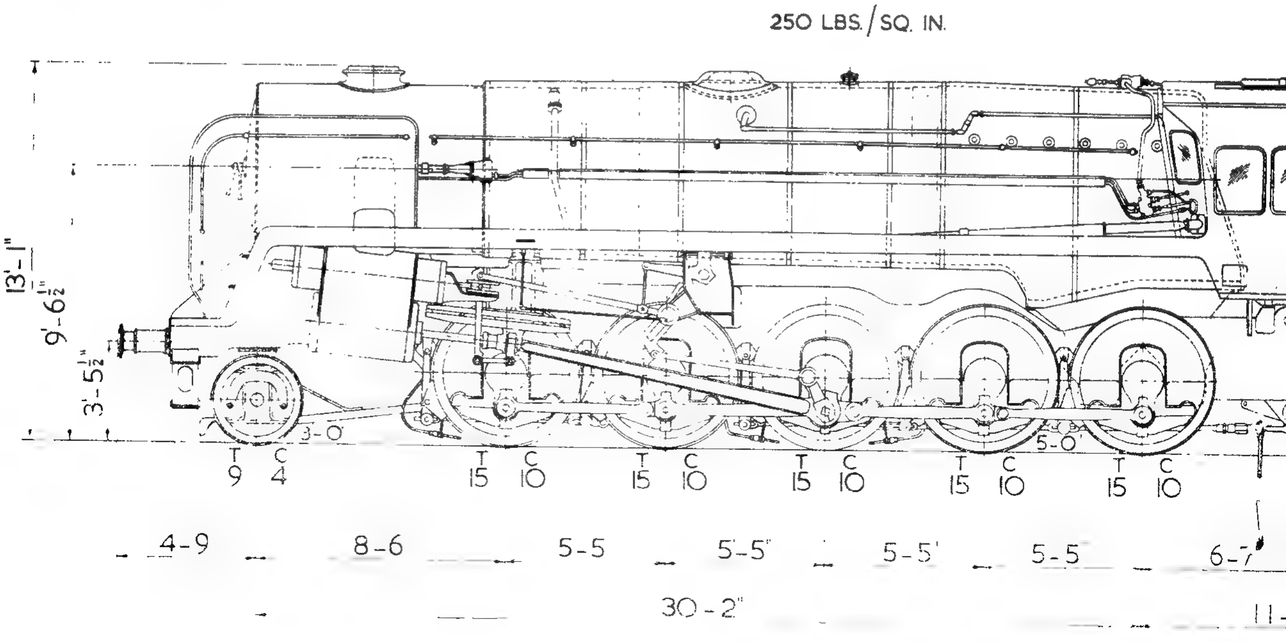


Britain's ne



THE ten-coupled steam locomotive, up to the present, has been but rarely used on the railways of Britain. The first example was the experimental 0-10-0 well-tank engine built at Stratford for the old Great Eastern Railway in 1902. This engine had a very short life and no more of the type were constructed. The second example came nearly seventeen years later, in 1919, when the massive 0-10-0 banking engine was built, at Derby, for helping trains to climb the well-known Lickey incline on the Midland Railway. This engine, known to many enthusiasts as "Big Emma," is still the only one of her class and is kept to the work for which she was built. Almost a quarter of a century passed before the third example made its appearance; this was the 2-10-0 "Austerity" freight engine designed by Mr. R. A. Riddles for dealing with the heaviest munition trains during the 1939-45 war, twenty-five of the engines being built at Crewe in 1943-4, and all of them are now in service on British Railways.

A fourth design of ten-coupled engine is now in course of delivery to the various regions of British Railways, and is a fine 2-10-0 heavy freight engine, ten examples of which will have been built at Crewe works before this winter is over. The design was prepared at Brighton works, under the direction of Mr. R. A. Riddles, although certain



ew "Decapod" Locomotives

sections were designed at Derby, Doncaster and Swindon. The drawing reproduced herewith shows the general appearance and gives the leading particulars of the new engines; but we were privileged to be invited to join a special party of technical Press representatives visiting Crewe to inspect the first four of these engines which had then just been completed. They were Nos. 92000-1-2 and 3, and were standing, side by side, just outside the paint shop. A striking contrast was provided by an old L.N.W.R. Webb "Cauliflower" 0-6-0 which, at the time it was first turned out of Crewe works, in 1887, was "the last word" in freight engines!

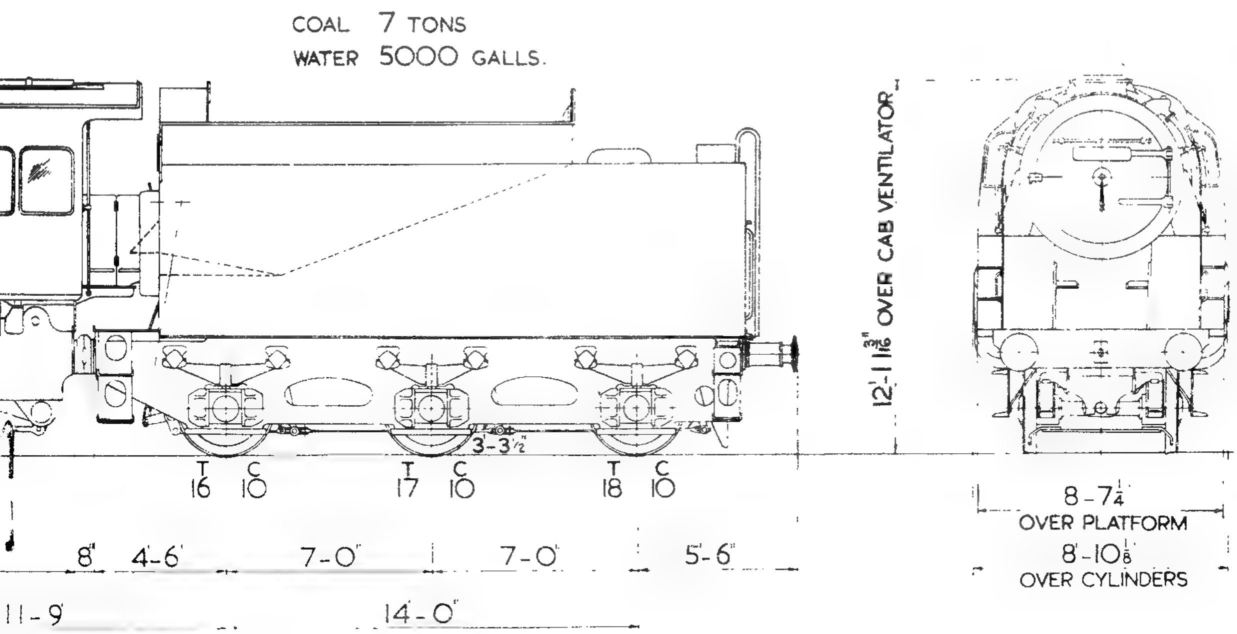
The mechanical engineers of British Railways have high hopes of No. 92000 and her sisters; it is scarcely possible to increase the loading of freight trains beyond the limits of that reached by the heaviest trains, but such engines as the new 2-10-0s will enable trains of 1,500 tons, or more, to be speeded up considerably, due to the ten coupled wheels being as much as 5 ft. in diameter.

The designers have been wise not to introduce any new and untried features on these engines: practically the whole of the equipment follows the new standard practice brought into use in 1948, and there are few, if any radical changes in details. For so large an engine, the axle weight is low, being only 15½ tons; this is imposed upon each of the coupled axles, but it means that a total of 77½ tons is available for adhesion. Yet, at first sight, the factor of adhesion is surprisingly low at 4.38; but this is quite a satisfactory figure when the large cylinder diameter is taken into account in conjunction with the high working pressure of 250 lb. p.s.i. which means that, in full gear and with the regulator wide open, the mean effective

BOILER	BARREL DIAMETER (OUTSIDE)	5'-9 INCREASING TO 6-1
	FIREBOX (OUTSIDE)	7'-5½ LONG x 7'-0⅛" TO 6'-6$\frac{7}{16}$" WIDE
	TUBES	35 LARGE 5¼" O.D. x 7 S.W.G.
		138 SMALL 2" O.D. x 11 S.W.G.
	SUPERHEATER ELEMENTS	1⅜" O.D. x 9 S.W.G.
	LENGTH BETWEEN TUBEPLATES	15'-3"
HEATING SURFACES:	TUBES	1836 SQ. FT
	FIREBOX	179 SQ. FT
	TOTAL EVAPORATIVE	2015 SQ. FT
	SUPERHEATER	535 SQ. FT
FREE FLUE AREA		5·49 SQ. FT.
GRATE AREA		40·2 SQ. FT

CYLINDERS (TWO)	20 x 28
TRACTIVE EFFORT	39,667 LB
ADHESION FACTOR	4·38
BRAKE % ENGINE & TENDER	69·8
MINIMUM RADIUS CURVE WITHOUT GAUGE WIDENING	6 CHAINS
BOILER TYPE	B.R. 9
TENDER TYPE	B.R. 1G

WEIGHTS	FULL	EMPTY
	T. C.	T. C.
ENGINE	86 14	78 0
TENDER	52 10	23 3
TOTAL	139 4	101 3



Grate and ashpan assembly

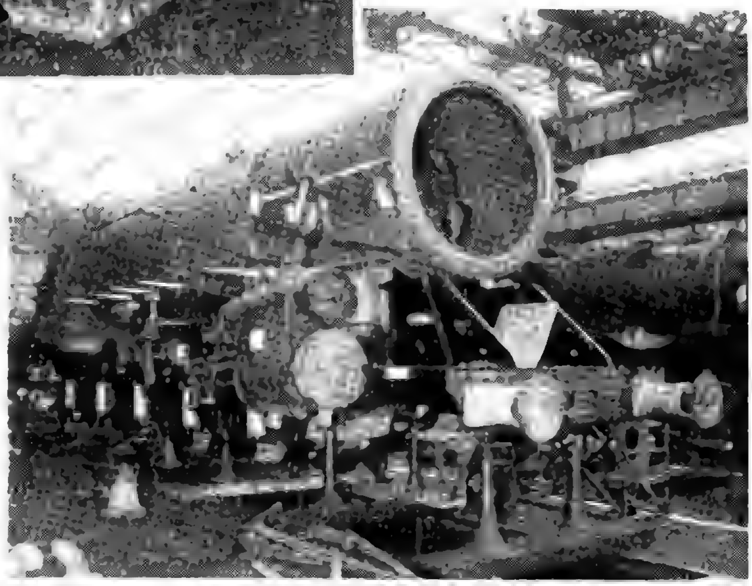
pressure on each piston is about 210 lb. p.s.i.; and that is a high value.

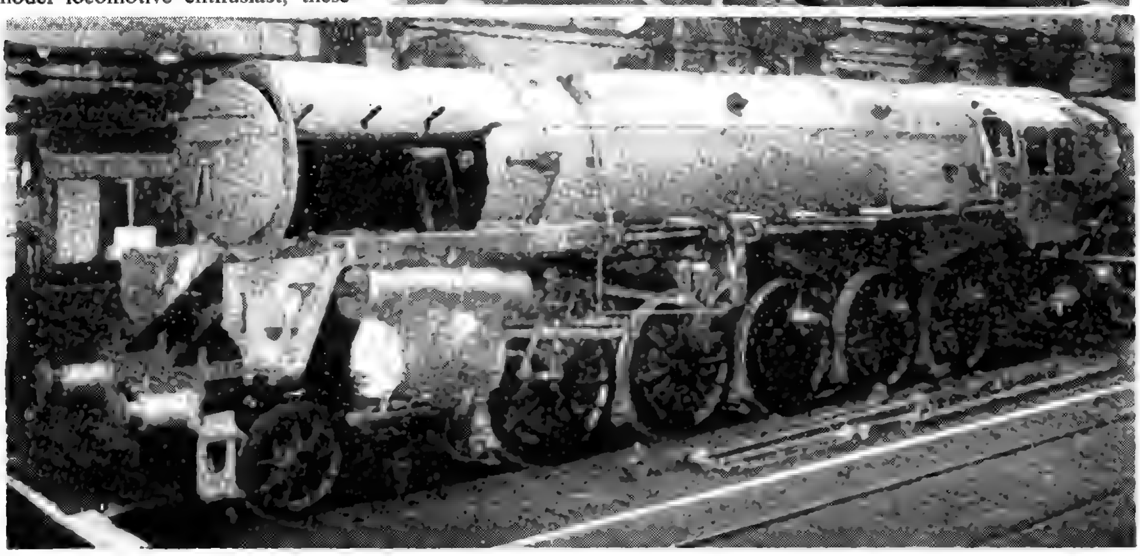
The tenders for these engines vary in type and capacity, depending upon the region to which particular engines may be allocated; where water troughs are comparatively plentiful, the tenders will have larger fuel capacity, but on a region where water troughs are scarce, or even non-existent, then the tenders will provide greater water space and carry less fuel.

A later batch of these engines will be provided with boilers of the Franco-Crosti type; this is an Italian invention designed to achieve a marked economy in fuel, and seems to have given some very encouraging results on Continental railways.

From the point of view of the model locomotive enthusiast, these engines offer some inviting prospects because of their massive proportions, their apparent speed capabilities and their excellent adhesion. The wheels on the middle coupled axle have no flanges, so that all normal curves should be easily traversed. The construction problems should not be any more difficult than those of *Britannia*. Even the unusual ashpan and rocking-grate assembly, reminding one rather of a pair of football shorts, is more interesting than difficult to make.

Below—Cylinders, boiler and frames assembled





Nearing completion. In this view, the wheels have been placed in position

MORE UTILITY STEAM ENGINES

A Double Tangye Type Mill Engine

By Edgar T. Westbury

TO continue with the machining of the main working parts of the engine, it is advisable now to make the pistons, piston-rods and crossheads, in order to enable their location to be checked up before deciding the exact length of the connecting-rods. The reason why this order of precedence is advisable is because in this engine the piston rod length is definitely fixed once and for all when the parts are machined, and there is no latitude for adjustment of cylinder end clearances, except by alterations to the connecting rods; and in view of the fact that cumulative errors can and do occur in constructing engine components, it is better to be safe than sorry when it comes to final assembly.

The pistons and rods can be made by the same methods as for the "Unicorn" engine, to ensure that they are exactly concentric with each other, and great care is necessary in forming the screwed end of the rod, together with the abutment shoulder, to ensure that it screws truly home in the crosshead. It is permissible to use a tailstock die-holder if one knows from previous experience that one can rely upon it, and also the particular die used, to cut a true thread; but it is safer to generate the thread in the lathe with a single-point tool, while the rod is set up truly for the other machining operations. The thread should be on the tight side, so that it fits the tapped hole in the crosshead without side shake.

Although the piston is shown with narrow grooves to take piston rings, this is purely optional, and unless the rings, and also the cylinder bore, are perfectly accurate and properly fitted, they will be worse than useless. My own experience is that for engines running on low pressure steam, with little or no superheat, packed pistons are not only satisfactory, but also work with less friction than those with rings, however well fitted; it is a different matter, however, when high pressures, temperatures, and speeds are involved.

If rings are used, I consider cast-iron is the best material for them, because although it is very fragile, and there is more than an even chance of breaking a ring or two in springing them on, this material does not readily take a permanent bend, or "set," as steel or phosphor-bronze is liable to do in the process, and which renders the ring quite useless. The outside diameter and two sides of the ring should be finished by lapping, and they should fit the grooves fairly closely at the sides, but with ample bottom clearance, and the smallest possible gap when compressed into the bore.

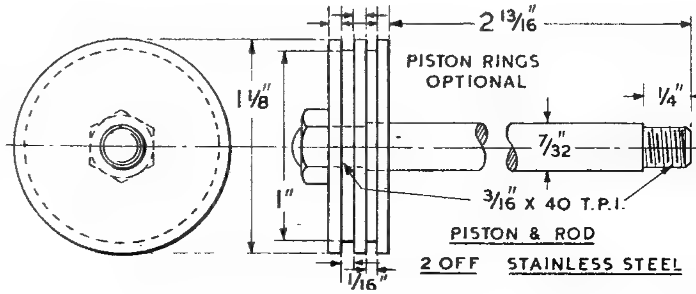
Altogether, making piston rings is a finicky business, and although I have made some hundreds of them in my time, I must admit that I have never obtained quite such good results with them as with rings made by the specialists in this line of business.

For packed pistons, a single groove about $\frac{3}{16}$ in. wide and deep should be substituted for the two narrow grooves, and graphited asbestos yarn used, as previously described. The material specified for both pistons and rods is stainless-steel, but if not obtainable, cast-iron is satisfactory for the piston head, and mild-steel rods will serve, if steps are taken to prevent it from rusting when the engine is not in use.

The crossheads may be made in either of three alternative forms; Mr. Ballantyne's engine followed what was probably correct prototype practice, by using a split wrist-pin housing with inserted split bushes, but as this feature is one which would only be visible on very close inspection of the engine, it is permissible to simplify construction by eliminating the split bushes, or even making the crosshead in one piece, with or without a solid pressed-in bush.

In either case, the general machining procedure for the crosshead can be carried out on much the same lines; I recommend chucking a piece of steel bar, with sufficient length projecting to machine the boss and the outer diameter at one setting, and roughing it down all over to a little over finished size. If a piece of rectangular bar, say $1\frac{1}{4}$ in. by $\frac{1}{2}$ in., is used, this will save a good deal of work on the sides of the crosshead, but further milling or shaping is required to produce the correct cross-section, and this may be done next, using a milling attachment in the lathe if available, to avoid taking the work out of the chuck. Should a shaper be used, however, it is advisable, before dismounting, to neck down the back of the crosshead with a parting tool to slightly under $\frac{3}{8}$ in. diameter, to give clearance for the shaping tool at the end of its stroke; alternatively, a cross groove can be made each side in the shaper for the same purpose.

The work is now returned to the chuck for finishing the turning

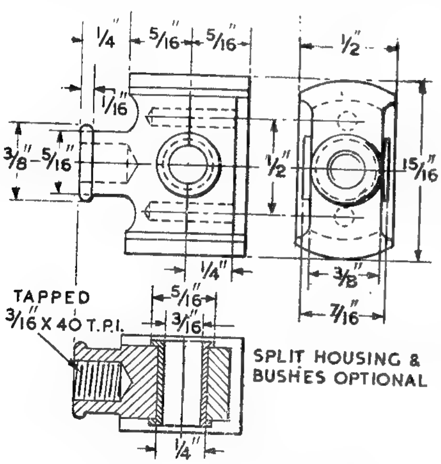


PISTON & ROD
2 OFF STAINLESS STEEL

Continued from page 119, *February* 4, 1954.

operations on the outside, and drilling and tapping the boss, which should be done very carefully, to ensure a true thread. As the piston-rod has to screw home to the shoulder, the first thread or so in the boss should be bored out to $\frac{3}{16}$ in. diameter to provide a clearance. The piston-rod may be tried in position, and when fully screwed home, should run quite truly. Turn the outer diameter of the cross-head to a fairly tight push fit in the trunk guide, to allow of taking down high spots with a fine file on assembly.

After parting off, the crosshead should be re-chucked in the reverse position, with slips of copper or aluminium sheet between the finished surfaces and the jaws, and set up to run as truly as possible for facing and counterboring the other side.



CROSSHEAD 2 OFF M.S.

This could perhaps be done by mounting it on a screwed spigot held in the chuck, but better rigidity of support will be obtained by direct chucking, and it is worth the extra trouble involved in setting up.

If the housing is to be split, the face of the crosshead is then recessed $\frac{3}{4}$ in. diameter to a depth of $\frac{5}{16}$ in., the bottom of the recess being finished dead flat to provide a seating for the separate piece, forming the bearing cap, which is made $\frac{5}{16}$ in. wide by $\frac{1}{4}$ in. thick, and turned over the edges to $\frac{3}{4}$ in. diameter to fit snugly into the recess. It is secured by two 8-B.A. studs, located at $\frac{1}{2}$ in. centres, as indicated by the dotted lines on the drawing. But if the crosshead is to be made solid, it is simply recessed $\frac{1}{16}$ in. deep by $\frac{3}{4}$ in. diameter; dummy studs and nuts might be fitted to make it *look* like a split housing, but I do not favour deliberate deception in details of this nature.

Incidentally, some constructors may think it a good idea to finish the outside of the crosshead after it has been screwed on to the piston-rod, by holding the latter in a collet chuck, or otherwise ensuring that it is truly concentric. At first sight it may seem that this will enable any error in the truth of the screwed joint to be compensated, but experience shows that it is really not such a good idea after all. In the first place, the support afforded by the rod is not sufficiently rigid to ensure accuracy of the finishing cut over the working surface of the crosshead; this might be remedied by running up the centre-drill into the face of the housing, and supporting it by the back centre during the finishing operation. But even assuming that the desired result is achieved, the crosshead will have to be unscrewed from the rod for assembly in the engine, and one cannot ensure that it will screw up again in exactly the same place. With threads, that, for any reason, are initially out of truth, anything may happen—and usually does!

Some measure of location adjustment of the pistons could be obtained by increasing the length of thread on the piston-rod and fitting a lock-nut; but here again, there is a risk of throwing the cross-head out of truth if the threads and faces are in the slightest degree inaccurate. I trust readers will pardon the emphasis on these details, but we are dealing with a type of crosshead which, while probably one of the soundest ever used in steam engine practice, is only satisfactory if it works perfectly truly; and unlike most other types, does not respond well to hand fitting on assembly. Of course, one can always resort to " butching and botchery "—filing away hard spots till the engine will hobble round—but that, dear readers, is not in my opinion, *engineering*—model or otherwise !

Boring for Wrist-pin

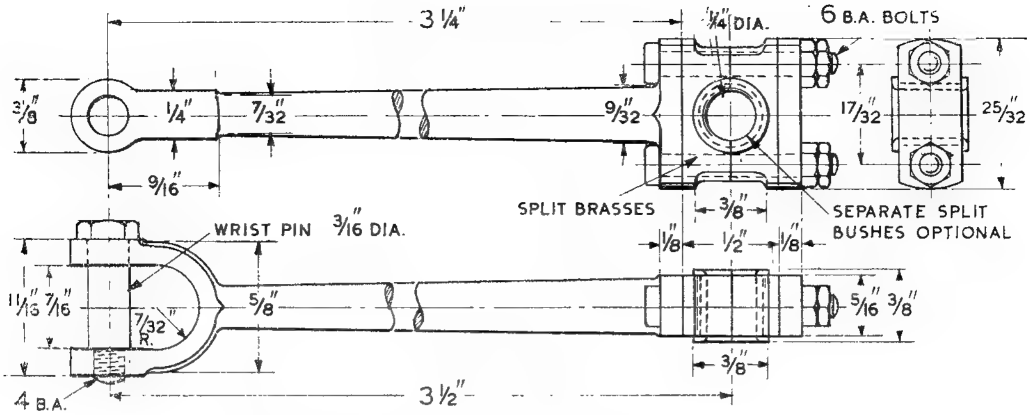
The crosshead must now be set up crosswise for boring the hole to take the gudgeon or wrist-pin. If the turning and facing of the main surfaces has all been carried out accurately, it can be mounted on an angle-plate, using a parallel packing-plate or ring, slightly over $\frac{1}{4}$ in. thick, and with a $\frac{3}{8}$-in. hole to clear the crosshead boss, so that it rests on the broad face, and it can be secured either by a strap and two bolts, or by a single stud screwed into the crosshead boss to take a nut on the other side of the angle-plate: the work involved at this setting is relatively light, but there must be no risk of it moving during drilling and boring. Set the angle-plate up on the faceplate so that the centre of the crosshead face runs truly, run in the centre drill, then put an undersize drill in cautiously, and open out with a small boring tool, finishing with a reamer if available.

For a split crosshead, the bearing cap should be secured in position; the bore should be $\frac{1}{4}$ in. diameter to take the bush, which has a flange at each end, and it is advisable to take a skim on the face, out to beyond the flange diameter, just in case the faces of the two parts do not line up perfectly level. The other side can be similarly treated by mounting the job on a $\frac{1}{4}$ in. mandrel. Make the split bushes as described for the main bearings, and fit them snugly to the housings, both on the diameter and between the flanges. If the crosshead is solid, it may be bored out $\frac{5}{16}$ in. diameter, and a bush of appropriate outside diameter, by $\frac{7}{16}$ in. long, pressed in so as to project equally either side. In all cases, of course, the bore is made the same size, namely $\frac{3}{16}$ in. diameter.

Connecting-rods

These can be made by exactly the same methods as those adopted for the rod of the " Unicorn " engine, as I have made slight modifications to the fork end to adapt it to these methods, while conforming to the essentials of the original design. One reader has suggested that it would be much easier to make forked rods from castings, as certain well-known firms have done in the past, adding that " if you want them to look like steel, they can always be plated." I leave it to constructors to judge whether these methods are really desirable, but I would observe that few of the cast rods I have seen have been clean or accurate enough to use without a considerable amount of filing and faking. Certain machining operations are essential if the job is to be mechanically satisfactory, and one great advantage of making these rods from solid steel is that they can be accurately and securely mounted for the delicate operations on the fork, prior to carrying out the relatively simple turning on the shank.

Before starting work on these



CONNECTING ROD 2 OFF M.S.

rods, a check should be made on the required length, for reasons already explained. The structural parts of the engine should be temporarily assembled, and the pistons put into the cylinders, also the crossheads screwed on. With the crankpin at dead centre, on the outer end of the stroke, the piston should be pushed in until it makes contact with the front cylinder cover. Measurement should now be taken between the crankpin and wrist-pin centres; to do this, a short piece of $\frac{3}{16}$-in. rod may be inserted in the crosshead bore, and the distance from this to the crankpin measured with inside calipers, trammels or slide gauge, adding the radius of the two pins, namely ($\frac{1}{8}$ in. + 3/32 in.) = 7/32 in., to give the true centre distance.

The crankpin is now turned to the opposite dead centre, and the piston moved until it makes contact with the outer cylinder cover (temporarily assembled), when another similar check is made. This should show an increase of $\frac{1}{16}$ in. over the former measurement, which is accounted for by the clearance allowance of 1/32 in. at each end of the stroke. By splitting the difference between the two measurements, therefore, the exact length of the connecting-rod between centres is arrived at. It is advisable to make this check on both ends of the engine, though with reasonable care in working to instructions, the measurements should coincide within a few thousandths of-an-inch, which is sufficiently close for all practical purposes.

I may mention that checks of this nature are quite common in the construction of full-size engines; unless a large number of exactly similar engines are produced, it is much simpler to work this way than to attempt working to close limits on every individual part. In some cases, end clearances of pistons are adjusted by using plates of varying thickness between the foot of the rod and the bearing brasses, as these clearances may alter during the working life of the engine, by reason of wear and refitting of the working parts.

Having thus ascertained the length of the rods beyond possibility of error, they can be set out and machined from $\frac{7}{8}$ in. diameter mild-steel bar. Reference to the photographs and description of the operations on the "Unicorn" connecting-rod, in the issue dated August 13th, 1953, will explain all essential points. One slight difference in this case is that the wrist-pin is made with a threaded end which screws into a tapped hole in one side of the fork; the reason for this is that only one side of the rod is accessible when the engine is assembled, unless the crosshead is attached to the fork before the piston-rod is screwed in, which is not very convenient. This applies only when the crosshead is made solid; if it has a split bearing, whether bushed or otherwise, a headless wrist-pin, pressed into the eyes of the fork, can be used, as in Mr. Ballantyne's engine. In this case, however, there is a risk of distorting the fork when inserting the pin, unless a spacer equal in thickness to the span of the fork is interposed during the operation.

The machining and fitting of the crankhead "brasses" may also follow the methods used for the "Unicorn," including the set-up for the cross boring operation *in situ*, to ensure that the axis of the hole is exactly parallel with that of the wrist-pin. If separate split bushes are to be fitted, the "brasses" are bored out to $\frac{5}{16}$ in. diameter, and the bushes made and fitted as previously described. Many engines of quite large size, for marine and stationary work which I have examined, have had solid crankhead "brasses," with cast-in white-metal linings, while others have been fitted with ready-made standardised split linings—probably a modern innovation.

Readers' Comments

A very large number of letters have been received from readers on the subject of Tangye engines, some of them containing useful information, or referring me to available literature on the subject. These are all gratefully acknowledged, and some of them may be published if space permits; they certainly prove that there is a wide interest in engines of this type, and mill engines generally, which, I trust, will eventually bear fruit in the construction of many more such models in the future.

It is quite clear that Tangyes made a remarkably wide diversity of steam engines for all conceivable purposes, and many of their horizontal engines employed the characteristic trunk guide integral with the main standard casting, also the double or single disc crank, as in this design. Up to the present, I have not found a record of one identical in respect of the heavy-rimmed flywheel, or the split crosshead with wide-forked connecting-rod; but I cannot believe that such an acknowledged expert as Mr. Ballantyne would have included these details without very good reason.

(To be continued)

IN THE WORKSHOP
BY DUPLEX

A Miniature Spray Gun

IN previous contributions to this journal we have described paint guns which were used for spray-painting articles actually made in the workshop, as well as some of the machine tool equipment.

Besides this, these guns were found capable of carrying out much of the ordinary household painting and distempering, and even the interior of the garage was given two coats of paint in a very short time. However, even with the spray cut down to a minimum, these guns are hardly suitable for giving very small articles a uniform coating of paint, so as to leave a really good finish. But when it came to painting optical work, shading drawings, and retouching photographs, it was realised that a much smaller spray gun was needed for this kind of work to ensure satisfactory results.

Moreover, with the thin-bodied lacquers and pigments used for these purposes, a low-pressure air supply is an advantage, especially when it can be accurately controlled by the fingers guiding the gun. As it is important to maintain the air supply at a constant pressure, in order to obtain even spraying, the main air reservoir should be fitted with a reliable valve capable of controlling the pressure within reasonably narrow limits. An alternative plan, and the one we use, is to maintain the normal pressure of 80 p.s.i. in the main reservoir and to lower this pressure to some 10 p.s.i., by means of a sensitive reducing-valve, for the actual air supply to the gun.

The complete, miniature spraying outfit is illustrated in Fig. 1; this shows the small gun standing upright

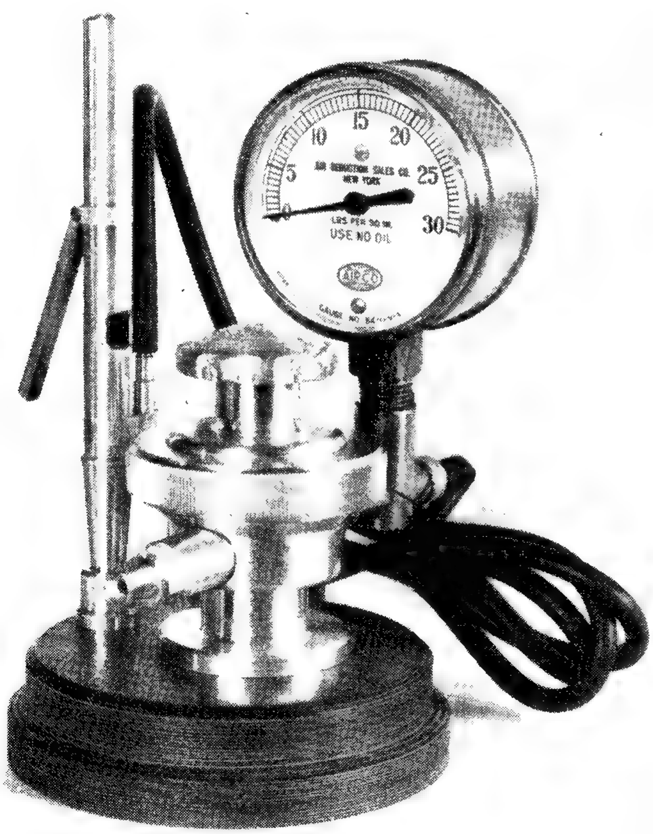


Fig. 1. The finished spraying equipment

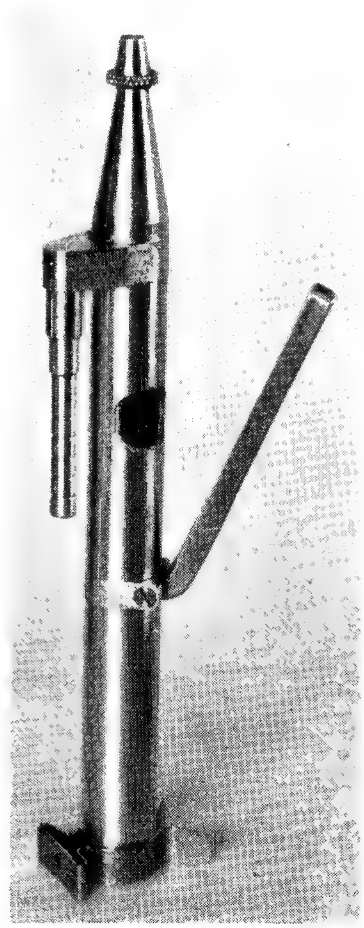


Fig. 2. The miniature spray gun

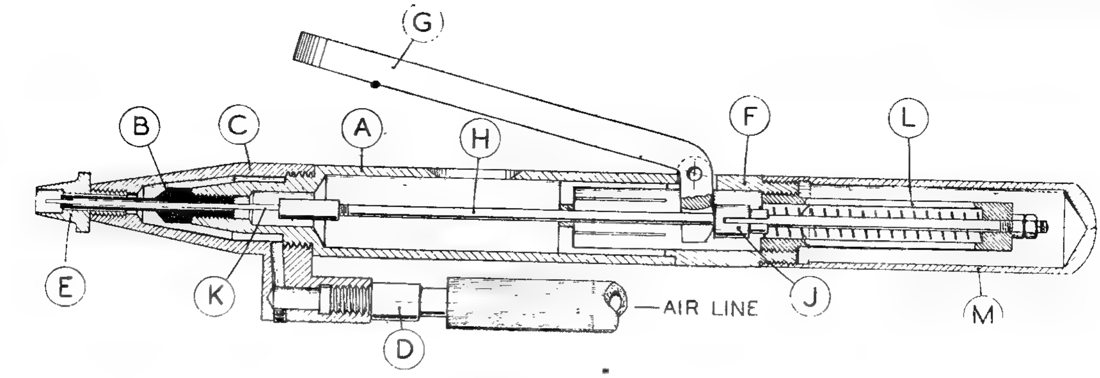


Fig. 3. Sectional drawing of the gun. A—the body ; B—the paint tube ; C—the air sleeve; D—the pipe union; E—the nose cone; F—the valve spindle housing; G—the trigger; H—the valve spindle; J—the valve spindle collar; K—the paint needle; L—the valve spindle guide; M—the cap

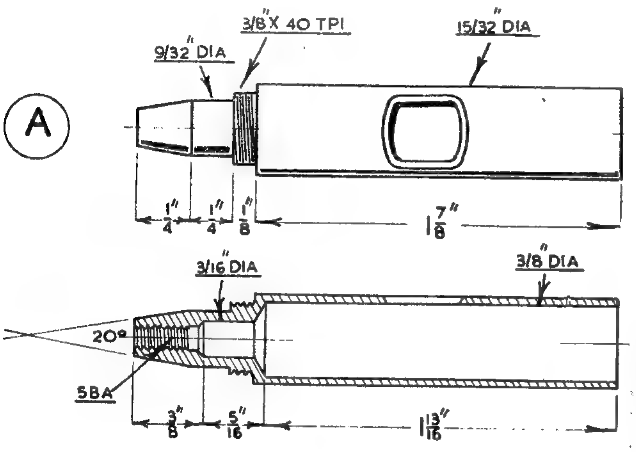


Fig. 5. The gun body

in its holder, the adjustable reducing-valve, and the necessary pressure gauge.

This apparatus has proved so easy to operate, and has given such good results, that it should be of value in many crafts where small pieces of workmanship have to be finished with a uniform, thin coating of paint in order to obtain a satisfactory appearance.

In this connection, we have noticed that in some exhibition ship models the fine workmanship put into deck fittings and other components has been entirely smothered by heavy and irregular painting; in fact, the full-scale thickness of the paint would in some instances amount to several inches.

Duralumin was chosen as the material for making the greater part of the gun, as it is light in weight, does not corrode, and is easy to machine to a good finish.

The Gun Body A

A length of duralumin rod was first turned on the outside to a smooth finish and, after being step-drilled, the work was reversed in the four-jaw chuck for turning the nose to shape and cutting the threads.

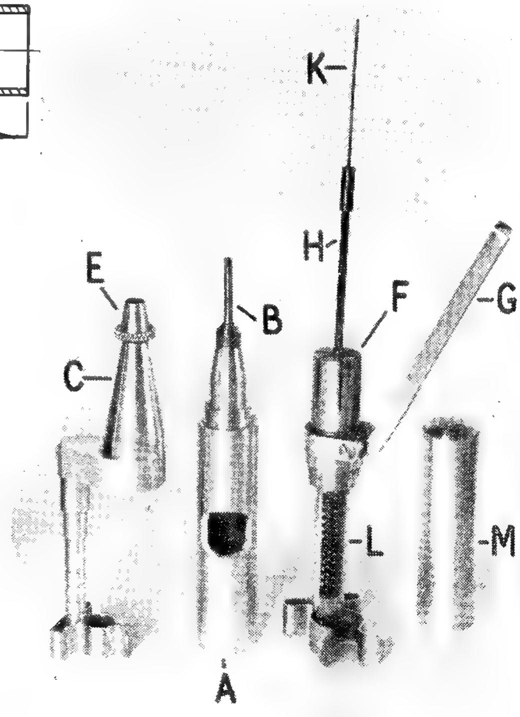


Fig. 4. The gun components

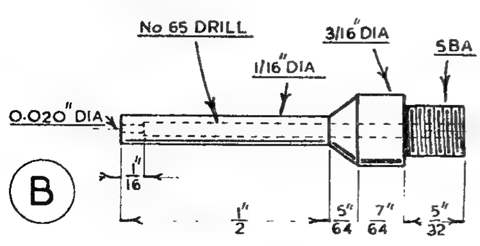


Fig. 6. The paint tube

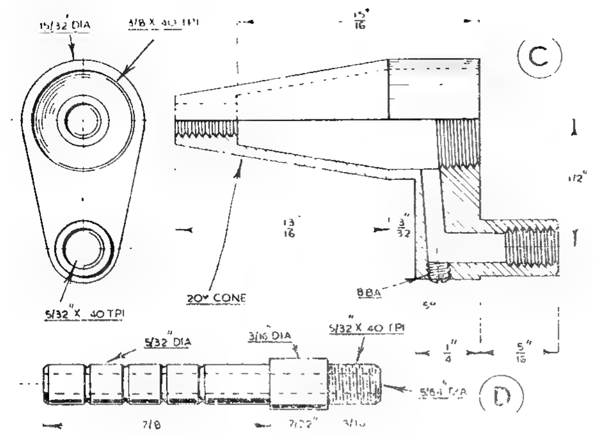


Fig. 7. The air sleeve and pipe union

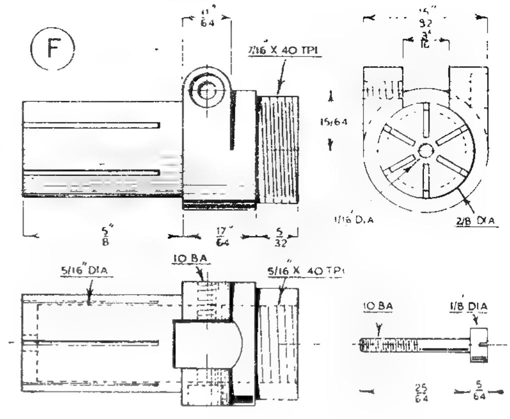


Fig. 10. The valve spindle housing

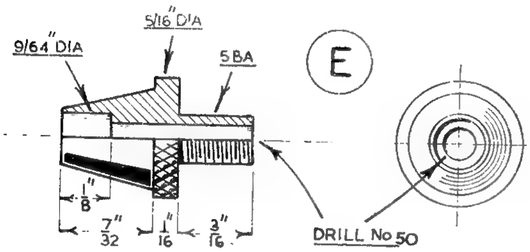


Fig. 8. The nose cone

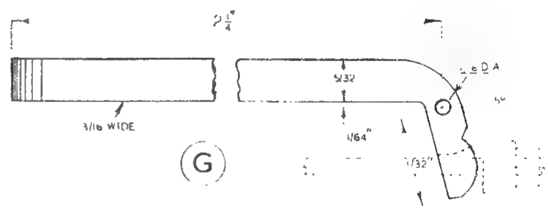


Fig. 11. The trigger

Finally, a window was cut in the side to serve as a filling hole for the paint.

The Paint Tube B

As this part is rather fragile, it was turned from a length of brass rod. The stepped bore should be formed first and, after the thread has been cut, the work is reversed for turning the smaller diameter at the tip. The part can be held by screwing it into a threaded adapter held in the chuck, and with the lathe running at high speed, a sharp knife tool is used for the machining. A No. 76 drill will serve for forming the 0.020 diameter bore, but if a drill of this size is not available, a small drill capable of forming a short bore in brass can quite well be made from an ordinary sewing needle.

The Air Sleeve C

This part was made from the solid in duralumin, and the final shaping and tapping of the coned end was carried out with the part screwed on to a threaded stub-mandrel held in the lathe chuck. After the air passages had been drilled, the smaller drill hole was closed with a grub-screw. Making the duralumin pipe union *D* and the nose cone *E* requires only straightforward drilling and turning. The method of assembling the parts so far machined is illustrated in Fig. 9.

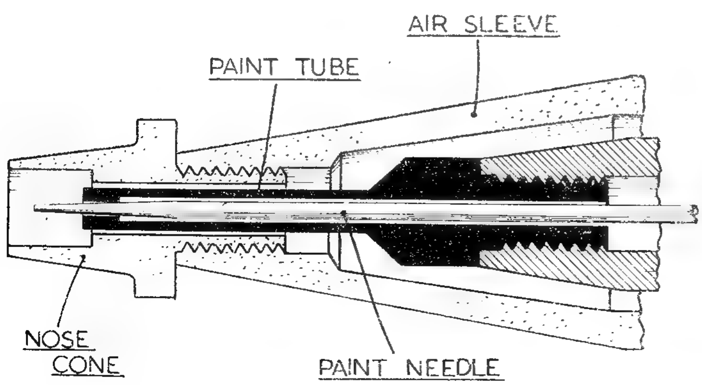


Fig. 9. Showing the assembly of the spraying components

The Valve Spindle Housing F

Again, this part will have to be cut from the solid in order to provide the cross-drilled lugs for carrying the trigger mechanism. The plain, slotted end of the housing is made a firm push-fit in the body of the gun, so that the trigger can be turned into a convenient working position.

The trigger *G* pivots on the 10-B.A. screw fitted to the housing, and the forked lower end of the trigger should be curved, so that it makes axial contact with the collar on the valve spindle as an aid to smooth working.

The Valve Spindle H

To resist corrosion, the valve spindle is made from a length of

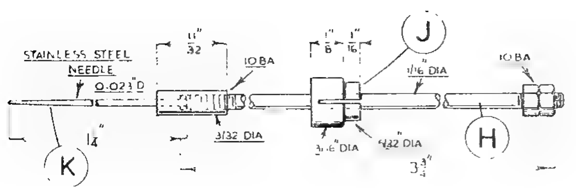


Fig. 12. H—the valve spindle; J—the spindle collar; K—the paint needle

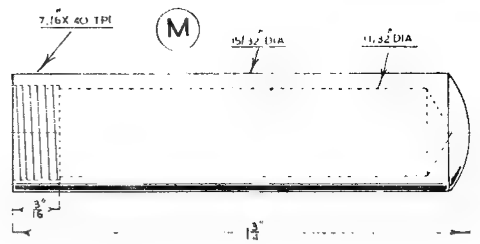


Fig. 14. The end cap

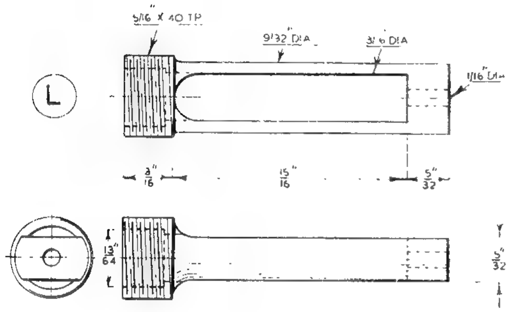


Fig. 13. The valve spindle guide

$\frac{1}{16}$ in. diameter stainless-steel rod. Both ends of the rod are threaded; one for mounting the paint needle and the other for the two lock-nuts controlling the forward travel of the spindle. The collar *J*, actuated by the short limb of the trigger, is made a firm press-fit on the spindle, so that its position can be accurately adjusted when assembling the gun.

The Paint Needle K

An ordinary sewing needle, with its point ground away, will serve for the needle controlling the paint flow, but if watery liquids are used in the gun, the part is best made from stainless-steel wire. The needle is made a press-fit in a brass collar which in turn screws on to the end of the spindle.

The Spindle Guide L

This component screws into the rear end of the spindle housing, and is drilled at its outer end to form a guide for the spindle. The small spring fitted carries the valve spindle forwards, and the backward movement is controlled by the finger pressing on the trigger.

The Cap M

The cap screws on to the spindle housing, and encloses the spindle guide and return spring.

When the gun has been finally assembled, the paint needle should project for about 3/32 in. beyond the tip of the paint tube, and the bore of the tube should then become sealed, so as to cut off the supply of paint and render the gun inoperative.

If necessary, the fitting of the trigger mechanism should be adjusted so as to move the valve spindle freely backwards and without deflecting it axially. The gun can now be charged with a thin-bodied pigment and given a trial with a low-pressure air supply. In the following article the construction of the pressure-regulating valve, to enable the gun to be connected to a high-pressure air line, will be described.

A MODEL POWER BOAT PIONEER

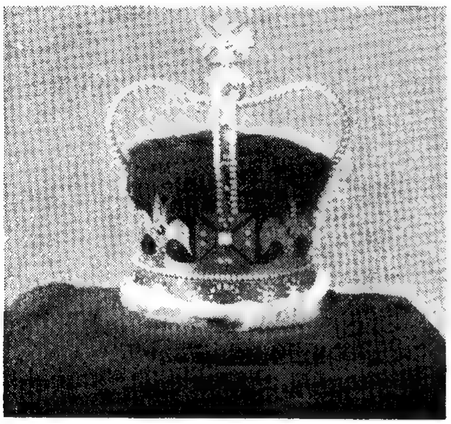
We greatly regret to learn of the death of Mr. H. Maycock, of Kettering, who was one of the founder members of the Wicksteed Model Yacht and Power Boat Club, and a very enthusiastic experimenter with petrol-driven racing hydroplanes up to the date of the war. He was also a very versatile and highly skilled craftsman in many other kinds of model work, and since his retirement some years ago, had spent a good deal of time in his workshop on jobs varying from horology to gunsmithing. There is no doubt that his cheery personality and ever-youthful enthusiasm will be sadly missed by the Wicksteed Club, but he has left them a good legacy in the example which he has set for the younger members to follow.

READERS' LETTERS

● Letters of general interest on all subjects relating to model engineering are welcomed. A nom-de-plume may be used if desired, but the name and address of the sender must accompany the letter. The Managing Editor does not accept responsibility for the views expressed by correspondents.

ANOTHER CROWN

DEAR SIR,—The letter from J. Hanson in the December 3rd issue interested me very much, as I was called upon to photograph just such a crown at the exhibition of the society of which I have the honour to be secretary, the Wyggeston School Craft Guild. The photograph shows the finished crown,



which bears a striking resemblance to that of Mr. Hanson. It was made by a third-former, aged 14, and is identical in construction to the other, with the exception of the large orb, which is a gilded table-tennis ball. The crown was originally made as an entry for a Coronation competition, and won First Prize; a sovereign presented by E. J. Freckingham.

It was generally thought at the exhibition that this model was very commendable, and was an inspiration to many other would-be craftsmen.

Yours faithfully,

Leicester. J. A. KEILY.

G.N.R. LOCOMOTIVE COLOURS

DEAR SIR,—In your reply about G.N.R. locomotive colours in the December 17th issue you say that the black lines on the wheels were edged with white lines. This was not so; the L.N.E.R. did use these lines but the G.N.R. never did, it was plain black arranged as you state, but the tyres were only painted black for about 2/3 of their width, the inside edge being green. Also, each spoke had a very fine black line right down its centre, joining together at the boss and forking out at the rim but not joining up.

I am not sure I agree that the G.N.R. green was much brighter than that used on the L.N.E.R.; it was certainly not as bright as the emerald green of artist's colours. The dark green border round the tender and side tanks was, in the later years, of the G.N.R. at least, of a very distinct bluish shade, and my recollection is that it was so at the beginning of the century.

I hope you will not resent my criticising your remarks, but I lived on the G.N.R. for some years at the beginning of the century, and in the early twenties I went to a good deal of trouble to get the green right when I was painting my 2-2-2 Stirling No. 875.

Yours faithfully,

Bexhill-on-Sea

C. M. KEILLER.

MODEL LOCO QUERIES

DEAR SIR,—I would be glad to know if any of your readers are making a 5-in. gauge L.N.W.R. "Precedent," as I have one on the way at the moment, though not very far, and I should like to compare notes on it from time to time as it progresses, particularly with someone who is interested in all details, both inside as well as outside and not just an outline representation. I have a good collection of drawings and photographs, etc. As an example, I am coming up to the cylinders stage, and there are many interesting points to be considered about these, as the port faces are inclined two ways, at 60 deg. included to each other and at an angle of 1-in-9 to the centre-line of the motion.

One point of general locomotive interest: have any of your readers ever tried out fitting the brake cylinder to the bottom of the boiler instead of the top, and so use water under pressure as a medium instead of steam, and so use a liquid instead of a gas similar to hydraulic brakes on a car? Depending upon the design of the valve, the brake cylinder need not be emptied each time to tax the boiler but only the pressure released. All condensation problems would be finished with, time lag would be abolished, or is there a snag? I cannot see one.

Yours truly,

Birmingham. W. FINCH.

TESTING BOILERS

DEAR SIR,—May I refer to "L.B.S.C.'s" article in the December 31st issue of THE MODEL ENGINEER wherein he quotes a test on a model boiler, which, being sound at 200 p.s.i. was further subjected to 300 p.s.i.—apparently just to see!

I do not wish to de-merit the members of the particular club in question who, I assume, knew what they were doing, but to would-be boiler testers the urge "to see," may I point out, could be dangerous. It is common practice to test a pressure vessel to twice its working pressure and if this is all that is necessary then I would advise leaving it at that. Too many people have a disregard for pressure, and a model boiler at 100 p.s.i. is no toy.

Yours faithfully,

Mirfield. K. HORROCKS.
A.M.I.Mech.E.

PADDLE STEAMERS

DEAR SIR,—I have read with much interest the articles and letters on Messrs. Cozen's paddle steamers at Weymouth, and would like to add what may be a few more lines o interest.

On Xmas Day the paddle steamer *Embassy* would have sunk in Weymouth harbour, had it not been for a passer-by, who late on that evening saw her decks awash.

An emergency call was sent to Weymouth Fire Brigade who sent two pumps to refloat her. On arriving they found that there was seven feet of water in her main saloons and engine rooms flooded; earlier in the day she had been used as an unofficial grandstand for spectators for the annual Xmas Day swim across the harbour.

Pumping was continued at full pressure until nearly 4 o'clock in the morning, by which time the

danger of the vessel foundering had been averted, pumping the remaining water from the engine room and other parts of the vessel continued until past midday on Boxing Day.

It is thought that an open valve above the water line may have submerged when the vessel listed.

Yours faithfully,

Dorchester. E. G. WHITE.

GEOMETRIC CHUCKS

DEAR SIR,—We note with interest your reply to C.J. (Leicester), and entirely agree with your statements therein. May we suggest that your correspondent, before doing more, should read the article entitled "The Geometric Chuck Adaptor" in 'Wood' August 1951 by the vice-president of the Society of Ornamental Turners, Mr. S. G. Askey. There he will find much practical information to guide him and the possibility or otherwise of producing a "predetermined" pattern.

Should your correspondent really require to do "engine-turning" (so called) on flat surfaces, then of course, he could do this by disconnecting the feedscrew of a lathe cross-slide and substituting a small crank driven directly from the change wheels.

One last thought; if your correspondent is being lured by the harmonograph designs which are creeping into advertising these later years, may I suggest that these are made by photographing a single design placed between two mirrors at an (acute) angle.

Yours faithfully,

Aylesbury. ARTHUR V. WALKER.

THE "CYGNET" ENGINE

DEAR SIR,—Mr. Westbury is to be congratulated on his design and general instructions for the above engine; I have just completed mine and it "goes like the wind."

Now, will you persuade him to finish the job and give us chapter and verse for suitable boiler and pumps, so that we may have a complete plant to put into a boat.

It is a very long time since we have had full instructions for a *simple* marine outfit, so please do spare us the space. These "loco" fans get pages and pages in *every issue*, and much as I love "L.B.S.C." and his amusing and instructive writings, I am getting jealous of the locomotive fraternity, who are so carefully guided from the cradle to the grave, while we poor marine types are left to wallow in our own "turtle soup."

Yours faithfully,

Dunkeld. R. NORMAN LOCKHEAD.

AN UNEXPECTED FIND

DEAR SIR,—I happened upon the subject shown in the photograph reproduced herewith last June, while on holiday in Scotland. I found it standing on the front of a village called Poolewe, at the head of Loch Ewe on the west coast of Ross.

I am afraid I know nothing of this type of mechanism, being interested principally in the making of tools; but, I know that a large number of your readers are keen students of these jobs. Perhaps the plate bearing the following will convey a lot to the cognoscenti:—Marshall Sons & Co. Ltd. 71396. Marshall's Patent Fire box 6490. I could see no other clues.

The photographs were taken with a Contax 2 Camera. Sonnar f2, 5cm. lens. 7/6/53. 10.40 a.m. 1/125th sec. f 5.6, with yellow green filter. Agfa Isopan F film developed in DK. 20 for 7 minutes at 67 deg.

Yours faithfully,

Kenton. B. STANLEY.

COURTESY (?)

DEAR SIR,—Before Christmas, an advertiser in THE MODEL ENGINEER asked for a copy of a certain book. Having a spare copy, I thought it would be a kindly gesture to post it to him, with my compliments and seasonal wishes. I asked nothing for the book or even cost of postage, but I did expect at least a postcard of acknowledgement. In this I was disappointed! If this letter meets his eye, I trust it will remind him that his omission does not foster the spirit between model engineers.

Yours faithfully,

Sheffield. J. GORDON HALL.

Glass-fibre

...the Possibilities

A MEDIUM WHICH OFFERS SCOPE FOR USE IN MODEL-MAKING

Repairing a car body, made by the N.E. Coast Yacht Building & Engineering Co. Ltd., with Bakelite polyester resin. When the resin hardens, the repair becomes integral with the rest of the body, and can be sanded and polished

WE hear a good deal about the use of glass-fibre in many engineering and industrial fields these days. Most of the information comes either in the form of vague and sometimes fanciful " popular " reports, or as abstruse technical data which few people care to sit down and painstakingly digest. It is the intention here to present the characteristics and possibilities of glass-fibre in a form which falls between the two extremes.

It is felt that many model makers and small-scale engineers will be interested in the material and its processing, as it may well lend itself to use in connection with the construction of boat hulls, vehicle superstructures of various kinds, model buildings, stage settings, scenery and the like. Production techniques are not in the least complex, as long as the right materials are selected, because the manufacturers of these materials have now developed ranges suitable for almost all possible applications, and can offer reliable guidance on processing.

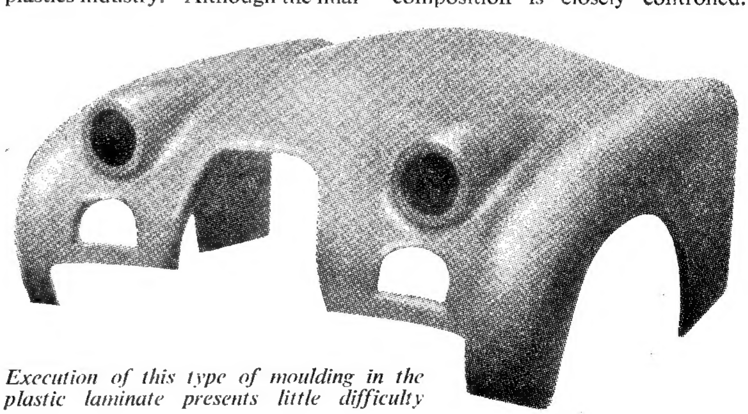
Briefly—very briefly—glass-fibre plastics are laminates, consisting of layers of woven, stranded or chopped glass, bonded with a suitable resin.

A certain amount of mystery may appear to surround the qualities of the material and its processing. It is perhaps true that the qualities are complex, but the processing is more or less straightforward. It is indeed fascinating and refreshingly simple, and one of the reasons why it appeals so strongly to the builders of " home-brew " sports cars, and small boats, is that no expensive plant is necessary. Production is not by any means outside the scope of the individual with a small workshop.

Of course, the simplicity of processing has resulted only from very prolonged and intensive theory and experiment on the part of the technicians and scientists in the plastics industry. Although the final product is simple and stable, and can be built-up so easily, its components are of a fairly complicated nature and their qualities must be determined within fine limits if success is to be obtained. However, we do not need to probe too deeply into the " backroom " work which has taken place, and which continues. For all practical purposes, here is a medium which can be handled easily and successfully by the engineer.

The process of formation has something in common with that employed by manufacturers of articles in papier mâché, whereby sheets or scraps of semi-pulped paper are put into a mould and bonded by means of some form of adhesive. In this case there is the same business of building up thickness with laminations of the basic material, and bonding it with an adhesive. The basic material, however, is glass-fibre—usually better known as Fibreglass, since the company of that name has for so long specialised in this manufacture—and some particulars of that material will be appropriate.

It is available in various forms suitable for reinforcement with plastics, or for reinforcing the plastic, as the case may be, depending on the respective strength-ratios. The various forms are made from continuous or staple filaments and their composition is closely controlled.



Execution of this type of moulding in the plastic laminate presents little difficulty

They have high resistance to weathering and to attack by most acids, alkalis and solvents. They are of very great tensile strength—something in the region of 250,000 p.s.i.—and are dimensionally stable. They are incombustible, and will withstand temperatures up to 600 deg. C. Of the various forms, woven glass cloth is probably the most common. Other forms are tape, chopped strand mat, diamond mat (continuous filaments laid in an elongated diamond or lozenge pattern) roving (continuous filaments wound parallel i.e. without any twisting of fibres), 2-in. chopped fibres, ⅞-in. chopped fibres, and surfacing mat—a glass-fibre tissue which holds and absorbs a high percentage of resin, thus giving a good surface finish.

The bonding agent is almost invariably a polyester resin. Low-pressure moulding techniques are employed, and are made possible because resins of this type evolve no volatiles during curing. Before going on to consider actual methods of constructing objects in the laminated plastic, some consideration of the qualities of these types of resin will be of value.

It was not until 1942 that the new series of resins known as polyesters became freely available, and allowed the manufacture of thermo-setting laminates using low pressures, that term being taken to imply pressures less than about 60 lb. per sq. in. in this case.

Unsaturated mono and polyhydric alcohols reacted with saturated and unsaturated polybasic acids give groupings of polyesters which are suitable for the type of bonding in question. All polyesters require the addition of a catalyst, usually of the peroxide type, to effect cure, either under heat or ultra-violet light, and for cold curing a promoter is also necessary. Polyesters can be hot or cold set. When the mixture is a hot binder, it consists of the resin, monostyrene, and the peroxide catalyst. A cold-setting polyester—usually used in the case of large structures—consists of the resin, monomer, catalyst and a promoter of the amino or naphthenate type.

To cheapen the resin and to improve and modify the properties, various fillers such as chalk, china clay, etc. can be used, and such resins can be coloured throughout by the addition of suitable pigments. It is a most important characteristic of the glass-fibre laminate that it is corrosion-free, as well as tremendously strong, and whilst it can be coloured by normal paint processes, the addition of pigment would render it quite independent of any painting or maintenance operations.

In passing, it is worth noting that polyester resins have many other applications apart from use in connection with laminates. They can be used, for instance, to make press tools for forming sheet metals, and for a variety of casting operations such as "potting" of electronic components and circuits, and the preservation of botanical and zoological specimens.

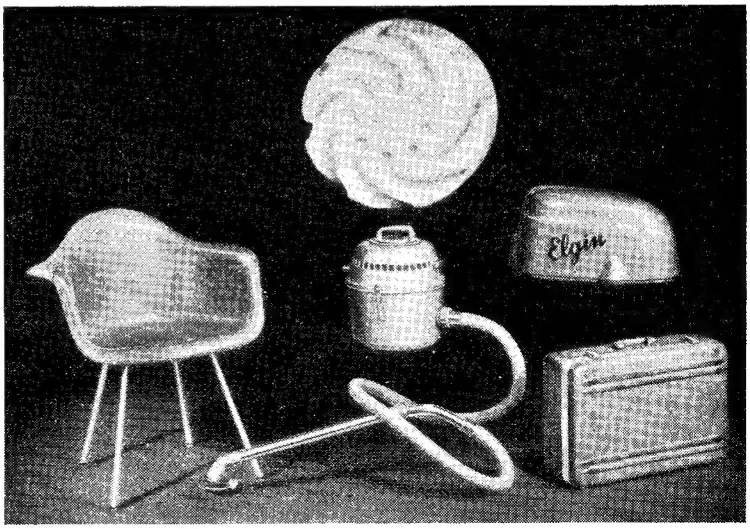
So much for the properties of the individual main constituents of a glass-fibre laminate. Before going on to consider fabrication methods (in a later article) the qualities of the complete finished laminate must be recorded, for they are of the utmost importance. The introduction of this medium is no "flash-in-the pan" and we will see much more of it in very many fields, in the writer's opinion.

These laminates have higher strength-weight ratio than aluminium, steel or magnesium. They can replace steel at a third of the weight, and at quite a reasonable cost these days. Impact resistance exceeds that of most metals, whether judged on a strength-weight or equal-thickness basis. Good weather and chemical resistance are among the most important features, but heat resistance depends upon the type of resin used. It can, however, be very high. Polyester resin may be treated so that the finished laminates will only support combustion while in actual contact with the flame source.

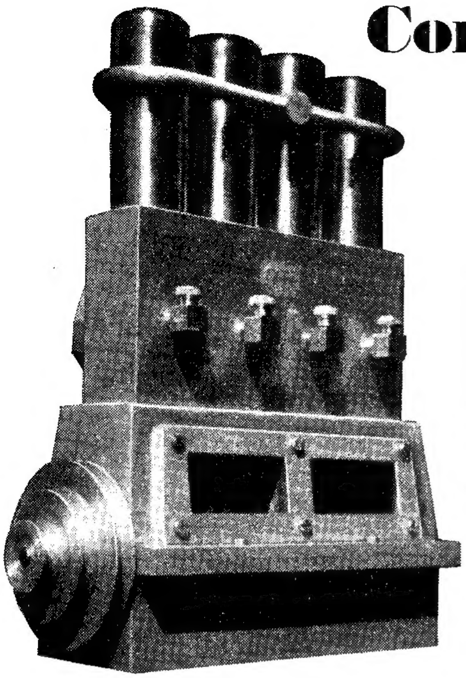
Articles can be formed on moulds made of low-cost materials such as wood, plaster of paris, and mild-steel, but brass or copper should be avoided. Complex shapes can be made in a single operation and much of the labour cost involved in making up metal components and assembling them can be avoided.

The writer has examined many examples of articles made in this material, and has been impressed by the remarkable strength possessed by a medium which strikes a most effective balance between rigidity and flexibility. For example, a car body made of this stuff can literally be kicked and jumped upon without suffering. If it buckles under really violent treatment, blows in the reverse direction will restore it to its normal contours. It is easy to work with normal hand tools, and yet is resistant to scratching and abrasion. Repeated and really violent hammer blows will eventually result in breakdown of the portion subject to impact, but the surrounding area will be unaffected, and in this respect it seems to resemble no other material.

Another notable virtue is that repair of any damaged area is a comparatively simple matter—certainly more so than would be the case with a fabricated structure. Some of the plastics manufacturers handling this medium, market repair kits consisting of small quantities of the constituents, and patching is not at all difficult, the area being afterwards sanded and if necessary painted. It is possible that model engineers might find such "field kits," as they are termed, of value for initial experiments.



Articles and components such as these made with Fibreglass and polyester resin—make clear the wide possibilities of the material



Corvus "Straight Four" HOT AIR ENGINE

By J. W. Corbett

As a sequel to the "Vee Four" described in the November 27th, 1952 issue of THE MODEL ENGINEER, this engine possesses several advantageous features. I have chosen a vertical type, first, because as there is no overhang of displacers and no side wear of power pistons, it is more efficient. The hot-end of displacers is also in the best position at the top. The tandem arrangement of pistons is similar to that of the "Vee Four" but in this case, four cranks are necessary, as cylinders are not set at 90°. The cylinder block and ports manifold are cast in one piece, and no transfer tubes are required, the ports being drilled in the solid metal. The ¼-in. steel crankshaft has three ball-bearings, and is totally enclosed, thus avoiding any oil-splash. Two windows are provided in front, so that the works can be seen; these are fitted with clear plastic "glass susbtitute." Lubrication is by splash from the sump but there are also four oilers to ensure oil being fed to piston-rods at the start.

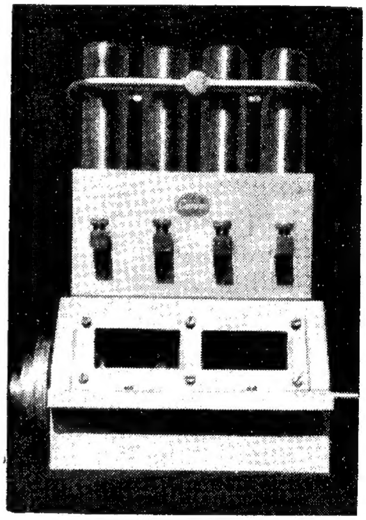
A further refinement is provision for water-cooling, consisting of a ¼-in. duct running the full length of cylinder block, in close proximity to air ports and piston-rods. This allows of greater heat being applied to regenerator tubes, and consequently more power being produced. The operation of the water system is by means of a small rotary pump, mounted at the back of the engine and driven from the main shaft. The transfer of power from regenerator to power cylinder is similar to that of the "Vee Four," viz.: each displacer is 90° ahead of one of the cranks, but not the one actuated in tandem. (See layout of ports in manifold.) Heat is supplied by a gas ring, serving all four tubes near the top; domestic, Calor or butane gas can be used.

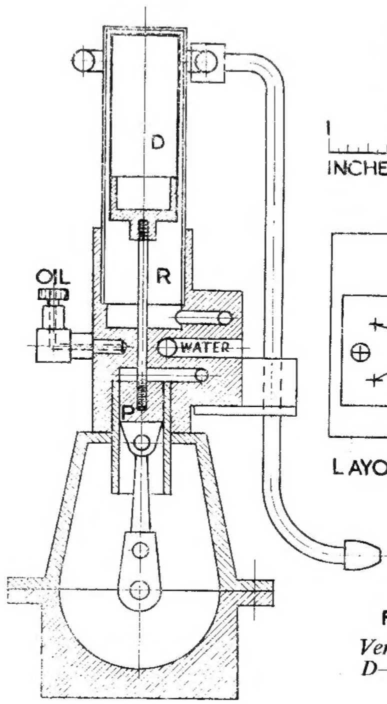
Materials

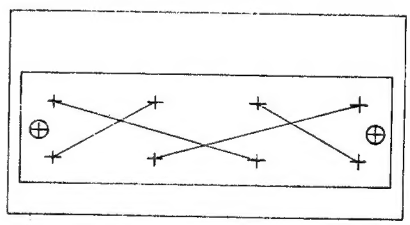
Cylinder block, crank chamber, sump and driving pulley.—Aluminium alloy.
Crankshaft.—All steel, built up.
Regenerator tubes and power cylinder.—Monel metal.
Power pistons.—Duralumin.
Displacers.—Aluminium tube.
Connecting-rods.—Gunmetal.
Piston-rods.—Silver steel.
Gas burners.—Brass tube.

Maximum Speed

1,200 r.p.m. without pump for short term running.
900 r.p.m. with pump, but more power.
900 r.p.m. with pump and dynamo.







LAYOUT OF PORTS ON MANIFOLD.
WATER DUCT ⊕

FOUR CRANKS AT 90°

Vertical section through one cylinder. D—Displacer; R—Regenerator tube; P—Power piston